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LARYNGECTOMY AND RADICAL NECK DISSECTION FOR CARCINOMA OF THE LARYNX.*

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Combined laryngectomy and radical neck dissection is advocated for advanced laryngeal carcinoma because ultimate success is dependent upon the first surgical excision. Secondary operations necessitated by recurrent or metastatic carcinoma decrease the likelihood of a permanent cure. Incomplete removal of carcinoma not only stimulates the growth of cancer but it causes increased suffering and early death. Excision must be radical, widely encircle the tumor through normal tissue and avoid transection of involved lymphatic pathways.

Advanced laryngeal carcinoma with cervical lymph node involvement has been stated to constitute an inoperable situation and irradiation has been recommended as the therapy of choice.[1,27] In our experience, as well as others,[7,11,12,14,22,38,39,43,45,46,50,55] irradiation for metastatic carcinoma has been so uniformly unsatisfactory that radical surgery has appeared justifiable. The division of the operation into two stages, laryngectomy followed by radical neck dissection, has given unsatisfactory

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results in that local recurrences frequently result (see Fig. 1). The two-stage procedure will cut involved lymphatics, which the one-stage operation avoids.

Fig. 1. Recurrent carcinoma destroying the cervical vertebra late after a delayed two-stage operation.

Prophylactic neck dissection with laryngectomy should be performed in all advanced laryngeal carcinoma because of the frequency of microscopic nodal metastases in impalpable nodes (see Fig. 2). The term "prophylactic" is used to modify the term radical neck dissection for an operation performed in the absence of palpable nodes. The operation is used in conjunction with the excision of the primary lesion and not as a separate and independent procedure as is ordinarily under-

stood by the term. Metastatic carcinoma constitutes the chief cause of late failures following laryngectomy. From a reported five-year cure rate of approximately 60 per cent,[42,50] postoperative cervical metastases have been estimated to occur in 30 per cent of the laryngectomy cases without preoperative indication of their presence.[15] The late appearance of metas-

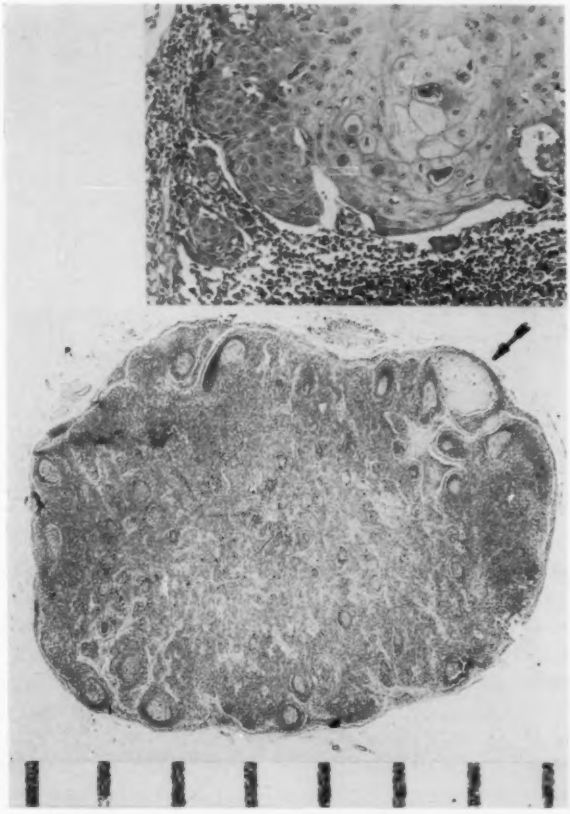

Fig. 2. The lower photomicrograph shows a tiny focus of metastatic carcinoma in a peripheral sinusoid of a cervical lymph node measuring 7 mm. (prophylactic neck dissection). Each line at the bottom indicates 1 mm. The upper figure is a high power view.

tatic carcinoma, in the absence of local recurrence indicates that it must have existed originally in impalpable nodes, or in a small palpable node considered "clinically not significant" by the surgeon.

Even with a most careful postoperative follow-up, many patients with late nodal metastasis after laryngectomy are

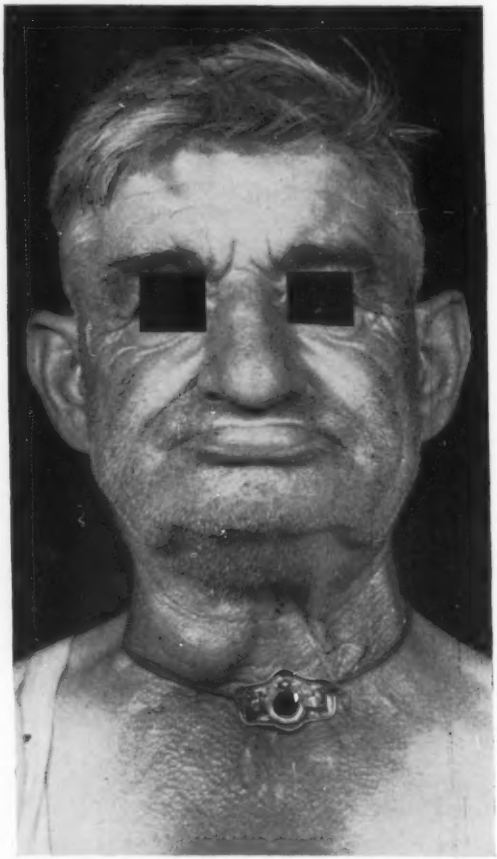

Fig. 3. Typical appearance of a firmly fixed metastatic carcinoma one year after laryngectomy for subglottic carcinoma.

doomed because of rapid growth and fixation of such lesions (see Fig. 3). Furthermore, the frequent appearance of nodes *low* in the neck may be associated with mediastinal extension, or the carotid or internal jugular vein may be involved by a tumor thrombus (see Fig. 4). It is obvious that success by radical neck dissection is less likely when palpable metastases exist than when a tiny solitary metastasis is present.

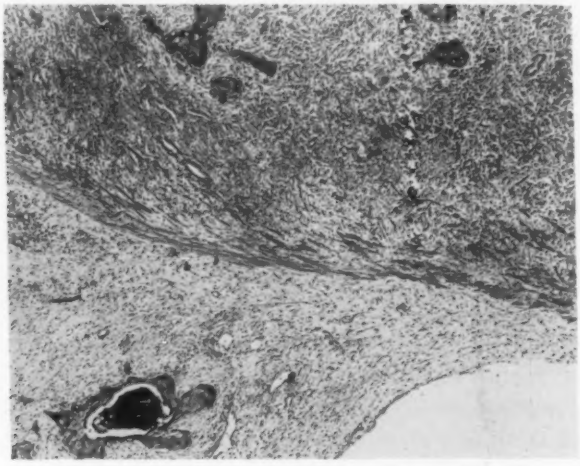

Fig. 4. Tumor thrombus in the internal jugular vein.

There should be no question at the first operation as to "how much" or "how little" should be removed. It is most essential that block neck dissection be complete. Partial neck dissection or local excision of nodes have no place in the treatment of cervical metastases. The emphasis is to excise the primary cancer and metastases widely and early before the nodes become clinically significant. To "wait and feel" for nodes after laryngectomy will invite many failures. Combined laryngectomy and neck dissection can be accomplished with little or no increase in the postoperative mortality rate as compared to laryngectomy. Furthermore, there is little difference in the cosmetic and functional results in the two procedures.

HISTORICAL DEVELOPMENT.

The first laryngectomy was reported by Billroth[8] in 1873. Until 1904 when Chevalier Jackson[26] gave the indications for and results of laryngofissure and laryngectomy, only a small number of cases were reported.[10,25,31,36,53] In 1904, Delavan[21] reported that out of 132 laryngectomies, 45 patients survived for varying periods up to 15 years. In 1905, LeBec[33] advocated the two-stage laryngectomy to avoid pulmonary complications. The two-stage method was again reported by Crile[17] in 1913, and by New[41] in 1928. At the Tenth International Congress of Otology in Paris in 1922, St. Clair Thomson,[57] Tapia, Delavan, Moure, Regaud, Coutard, Chevalier Jackson and others gave a full account of the progress in the treatment of carcinoma of the larynx. In 1930, Sorenson[54] reported 470 cases, of which 141 were free of disease five or more years later. Babcock[5] in 1931 demonstrated the wide-field laryngectomy. Laurens[32] advocated the laryngectomy with "U" skin flap incision. Crowe and Broyles[18] reported a number of cases of laryngectomies where the external perichondrium was separated from the thyroid cartilage and used for a "stiffer" repair of the pharynx.

The end-results of laryngectomy have been disappointing in that there is a significant percentage of local recurrences and cervical metastases.

Orton[44] reported 94 patients with 23 recurrences. It was significant that in subglottic carcinoma, five cases out of 15 had late cervical metastases following laryngectomy. Jackson and Jackson,[27,28] reporting on 95 laryngectomies, found that 36 per cent of these were in good health three years or more after the operation. Of these, 31 eventually died of fatal recurrences and 16 cases developed late cervical metastases. Schall[50] found a five-year survival of 64 per cent, while New[42] reported 60.2 per cent.

The value of radical neck dissection for metastatic squamous cell carcinoma was first described by Crile[16] in 1906. Brown and McDowell[11] and Martin[38] have recently stated that this form of surgery is a well accepted procedure.

In 1942, Sylvester-Begnis[25] advocated the use of radical neck dissection and laryngectomy as a one-stage procedure. He condemned the surgical extirpation of the larynx followed by irradiation therapy for clinically palpable nodes in the neck, as suggested by Vasconcelos.[39] Myerson[29] described two cases of extrinsic laryngeal carcinoma where a radical neck dissection was done first, followed a week later by a laryngectomy. One of the two patients died later of pulmonary metastasis. Kernan[30] in 1942 advised laryngectomy and radical neck dissection for extrinsic carcinoma of the larynx. Brunschwig[12] in 1943 and Del Sel[22] in 1947 advised bilateral neck dissection and laryngectomy for carcinoma of the larynx. Clerf[14] in 1948 stated that laryngectomy and prophylactic radical neck dissection were indicated in cases with questionable nodal involvement. In his series of 176 cases treated by laryngectomy alone, 81 were living, well and free of recurrence five years later. Forty-one out of 176 (24 per cent) showed late cervical lymph node metastases following laryngectomy. Of the 41, block neck dissection was carried out in 21 cases with seven surviving for five years or more. Of the 20 not treated surgically, 15 of the 16 given irradiation died with cancer. Pricolo[46] in 1948 published his technique for the one-stage removal of the larynx and cervical lymph nodes.

LYMPHATICS OF THE LARYNX.

The lymphatic supply of the larynx has been extensively studied by Rouviere.[48] The lymphatics are divided by the true cord into the supraglottic and the infraglottic collecting chains, as shown in Fig. 5. The supraglottic chain, which numbers four to six vessels on each side, is united in the form of a lymphatic pedicle near the anterior part of the aryepiglottic fold. The lymphatic pedicle penetrates to the pyriform sinus where it is united with the lymphatic trunk from the inferior part of the pharynx. Fig. 6 illustrates how this trunk traverses the thyrohyoid membrane, accompanied by the superior laryngeal vessels. Some of the collecting trunks are joined with those of the pharynx and are reduced to three or four vessels. The collecting trunks diverge at the lateral border of the thyrohyoid muscle. One ascends and passes

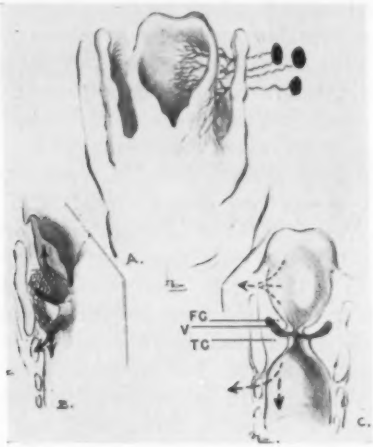

Fig. 5. Lymphatics of the larynx and laryngopharynx. Supraglottic and infraglottic collecting pedicles. FC—false cord; V—ventricle; TC—true cord.

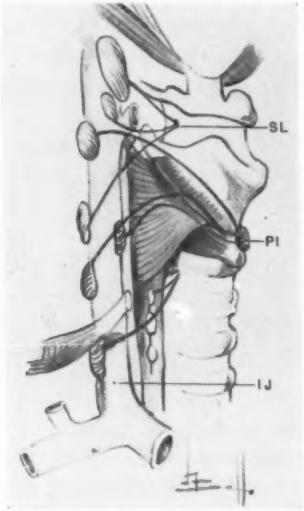

Fig. 6. Lymph nodes about the internal jugular vein. SL—superior laryngeal vessel opening. PI—prelaryngeal; IJ—internal jugular vein.

laterally and superiorly along the greater cornu of the hyoid bone to the medial side of the hypoglossal nerve terminating in the subdigastric node. One or several of the others pursue a somewhat more transverse course, and reach the nodes in the vicinity of the thyro-lingual-facial venous trunk, anterior and lateral to the internal jugular vein. Still others pass obliquely, inferiorly and laterally, and reach one of the nodes placed along the internal jugular vein between the thyro-lingual-facial trunk and the omohyoid muscle.

The infraglottic collecting trunks are composed of three pedicles: one anterior and two lateral posterior groups. Of the anterior group, the upper half traverses the cricothyroid membrane to the prelaryngeal node situated anteriorly between the thyroid and cricoid. This in turn empties into nodes near the internal jugular vein between the thyro-lingual-facial venous trunk and the omohyoid muscle. The lower half reaches the pretracheal nodes anteriorly between the cricoid and the first tracheal ring in front of the isthmus of the thyroid gland. The nodes in turn drain into the internal jugular trunk, as shown in Fig. 7. The two lateral posterior col-

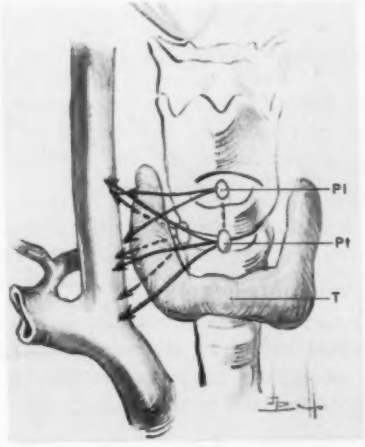

Fig. 7. Pretracheal and prelaryngeal lymph nodes. Pl—prelaryngeal; Pt—pretracheal; T—thyroid.

lecting trunks traverse the cricotracheal membrane to reach the medial border of the lateral lobes of the thyroid gland. From there they empty into the internal jugular vein nodes. Fig. 8 illustrates the rich lymphatic network in the neck and also the direction of lymphatic drainage.

Fig. 8. Cervical lymphatics.

CLASSIFICATION OF CARCINOMA OF THE LARYNX.

Since a great deal of confusion has surrounded the precise classification of carcinoma of the larynx, it is well for the purpose of this paper to clarify our terminology. We have chosen to follow Walsh's[60] classification:

1. Intrinsic is a tumor confined to the true vocal cord. The cord must be movable. The tumor may cross the anterior commissure and extend down the opposite cord.
2. Endolaryngeal refers to all tumors within the voice box; that is, tumors that involve the ventricle, false cords, and/or fixation of vocal cord.
3. Subglottic is a primary tumor that arises just beneath the true vocal cord. Such a tumor is extensive when it

involves the true vocal cord. A true cord carcinoma that extends supraglottic and/or subglottic is no longer intrinsic.

4. Extrinsic is a primary lesion that involves the epiglottis, aryepiglottic fold, or pyriform sinus. Postcricoid carcinoma is classified as esophageal in origin.

EVOLUTION OF THE ONE-STAGE LARYNGECTOMY AND RADICAL NECK DISSECTION.

Two principal factors appear to have stimulated the trend towards more radical surgical procedures in the treatment of carcinoma of the larynx:

1. Roentgen therapy alone has failed to give satisfactory results.
2. Laryngectomy for advanced carcinoma without apparent lymph node involvement has also failed in significant percentages. Subsequent local recurrence and late metastatic carcinoma have been the chief causes for failures.

Roentgen Therapy. In the hands of radiologists who have advocated the use of external irradiation for laryngeal carcinoma, therapy guided by daily laryngeal observations has given satisfactory results in certain cases.[1,6,19,20,29,34]

For early carcinoma limited to one true vocal cord, the results by irradiation are good and almost approximate those of surgery;[31] however, the results of X-ray therapy are poor where there is fixation of the arytenoid,[34] where the tumor is subglottic, or where the lesion involves the pyriform sinus.[6,20,29]

In our experience, Roentgen therapy has been reserved only for extensive anaplastic lesions, where surgery is contraindicated due to extent, or where surgery has been refused or deemed inadvisable because of the very poor physical condition of the patient.

Our results have been uniformly unsatisfactory in those patients where cervical lymph node metastases have been

treated by irradiation. Over the past 20 years, there have been no reported "five-year cures" with this treatment where metastases was proven by nodal biopsy.[11] Simmons[52] reported 108 cases and Forsell[24] reported 72 cases treated by external radium and Roentgen radiation without a single cure.

All of the reported five-year cures from irradiation, in which positive nodal biopsies were taken, have been the result of interstitial radiation from radon seeds implanted directly into the nodes after surgical exposure. Results reported from the Memorial Hospital[23,29] show not more than 2 per cent variation, in an approximate 20 per cent cure rate from surgery, and 4 per cent cure rate from irradiation (interstitial radon implants).

It is debatable whether irradiation will effectively sterilize even a small metastatic lymph node in *every* instance. Martin[38] has stated that a small metastatic node can be cured by external irradiation. Arbuckle[4] has reported that laryngeal carcinoma involving structures other than the true cord often shows microscopic metastases in nonpalpable cervical lymph nodes. He reports some clinical successes with external irradiation where biopsy of lymph nodes prior to therapy revealed microscopic carcinoma. Kernan[30] has suggested heavy X-ray therapy to the neck following laryngectomy in the absence of clinically palpable cervical nodes. It has been our experience that in some instances clinically positive nodes have appeared beyond the border of the treatment port.

Recurrent Carcinoma Following Laryngectomy.

1. Local Recurrence. The type of laryngectomy performed is critical. There should be no question as to the method of laryngectomy once a decision has been made to remove the larynx. Only a wide field insures an adequate margin of safety. The importance of the pre-epiglottic space has been emphasized by Bisi[9] and Clerf.[13] If the narrow field approach is attempted, and the body of the hyoid bone split, the pre-epiglottic space is inevitably exposed. Since this space is frequently involved with tumor, and a safety margin in such

an approach is not possible, extension into the base of the tongue is then likely to occur. Not only is the prelaryngeal node frequently involved, but carcinoma may also extend beyond the confines of the cartilages and spread into the ribbon muscles[50,51] (see Fig. 9). For this reason their separation from the cartilages should be avoided.

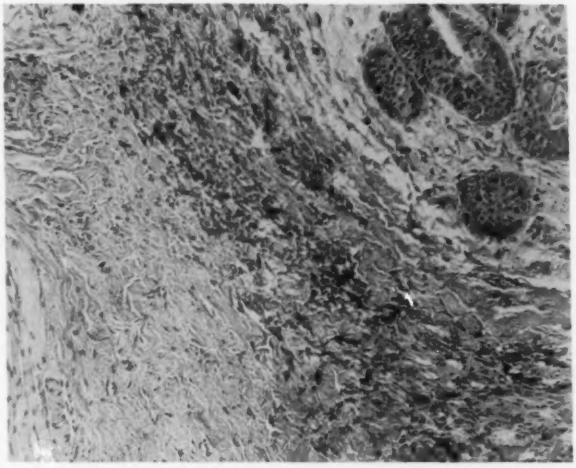

Fig. 9. A small focus of metastatic carcinoma invading the sternohyoid muscle.

Recurrences around the tracheal stoma sometimes occur; therefore, for a margin of safety, it is better to divide the trachea below the first ring than beneath the cricoid cartilage. All areolar tissue from the space of Burns and paratracheal areas is removed.

There may be some question as to involvement of the thyroid gland when it is placed over the thyroid or cricoid cartilage; for example, in subglottic carcinoma. If the isthmus is high over the first pretracheal ring, it is frequently adjacent to a pretracheal node. Under these circumstances, the isthmus and/or one homolateral lobe of the thyroid is resected with the larynx (see Fig. 10).

2. Cervical Lymph Node Metastases. Cervical lymph node metastases are reported as high as 71 per cent in extrinsic carcinoma of the larynx.[56] Metastases are frequent in subglottic and endolaryngeal carcinoma, but are very rare with intrinsic carcinoma limited to the true cord.

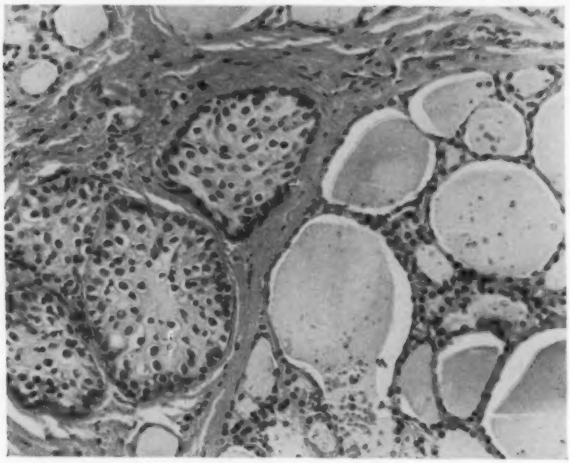

Fig. 10. Metastatic carcinoma in lymphatic channels of the thyroid gland.

SURGICAL INDICATIONS.

Type and Local Extent of Primary Lesion. In most instances, the lesions below will be unilateral:

1. Subglottic carcinoma.

2. Endolaryngeal carcinoma. The tumor may extend into the aryepiglottic fold or into the pyriform sinus on the same side.

3. Carcinoma of the aryepiglottic fold and/or the pyriform sinus. Secondary cordal fixation or arytenoid edema is frequently present. When a lesion of the pyriform sinus with cordal fixation or arytenoid edema

is present, it is important to determine the superior extent of the lesion. The superior margin of the tumor must be below the level of the hyoid bone.

The following method has been satisfactory for determining this extent: If the examining tip of the laryngoscope is just engaged on the tip of the epiglottis and the laryngoscope is then turned towards the side of the lesion, the superior margin of the tumor should be below the tip of the instrument.

Nodes. Unilateral, enlarged, solitary, firm, movable nodes are indicative for a combined laryngectomy and therapeutic radical neck dissection. Any enlarged palpable node not characteristic of carcinoma should be considered positive and have combined neck dissection and laryngectomy.

In the *absence* of palpable nodes, carcinoma that involves the aryepiglottic fold, pyriform sinus, subglottic and endolaryngeal areas should have a *prophylactic* radical neck dissection with laryngectomy. If exploration of the carotid sheath opposite the side of the lesion reveals questionable glands, bilateral neck dissection should be performed. Bilateral prophylactic neck dissection with laryngectomy is indicated where the lesion is very extensive and involves both sides of the larynx.

Grades. In the past, Grades I and II were considered radioresistant, and more amenable to surgery, while Grades III and IV were considered radiosensitive. While this is generally true, it is important to bear in mind that the term radiosensitivity is not synonymous with radiocurability. A biopsy made from the vocal cord which shows Grade I or II may on reaching the extrinsic areas show Grade III or IV.[27] Grading is, therefore, significant in that an anaplastic carcinoma is distinctly unfavorable because of its tendency to infiltrate the lymphatics early and to penetrate well beyond the apparent limits of the lesion. What appears to be a limited lesion showing anaplastic carcinoma is better treated by the one-stage radical surgery followed by postoperative irradiation. Occasionally radical surgery has been performed following

completion of irradiation; for example, a very extensive lesion (Grade III or IV) considered "inoperable" may later become "operable" in that the lesion is reduced in size.

Age. A combined radical procedure is more advisable for the younger than for the older individual. It is more important to consider the physical age than the chronological age.

LIMITATIONS.

A widefield laryngectomy without neck dissection is sufficient when an intrinsic lesion has extended too far for laryngofissure or other intralaryngeal procedures as advocated by LeJeune.[35] An instance of this would be carcinoma on both true cords or one which *just* spreads into the ventricular or subglottic areas. Another example would be where pathological examination of the laryngofissure specimen shows carcinoma at the surgical margins. Secondary widefield laryngectomy is then performed. It is a well known fact that cervical lymph node metastases occur very rarely under these circumstances.

Extent of Primary Lesion. This technique is not applicable where any one of the following conditions exist:

1. Clinical invasion of base of tongue.
2. The superior margin of tumor on the lateral laryngopharyngeal wall extends above the hyoid bone.
3. Carcinoma involves the posterior laryngopharynx.
4. Postcricoid carcinoma.
5. Common party wall involvement.

In the above areas, in addition to laryngectomy and neck dissection, the esophagus and/or pharynx must be resected similar to the technique described by Brunschwig.[12] The Alonso[2,3] or Orton[43] procedures are applicable to certain extrinsic lesions where there is an absence of cordal or arytenoid involvement.

Nodes. Surgery is contraindicated when there is complete fixation of nodes. It is of questionable value in the presence

of large bilateral firm cervical metastases. Bilateral metastases are unusual, and are usually associated with inoperable far advanced bilateral laryngeal carcinoma. Bilateral radical neck dissection with removal of both internal jugular veins in one stage has been performed in some cases.[38]

Grade. Any palpable metastases showing anaplastic carcinoma, despite movability, is no longer limited. Under these circumstances mediastinal extension is invariably present.

General. Irradiation is indicated in the following conditions:

1. The local or metastatic lesion is "inoperable."
2. Distant metastases.
3. The aged or very poor surgical risks.

TECHNIQUE.

Anesthesia. The skin is injected with 1 per cent novocaine. Using heavy barbiturate premedication, local anesthesia may be used until the tracheal stump is delivered. Gas, oxygen and ether endotracheal anesthesia supplemented by Demerol and Pentothal is then started.

A "U" incision is marked out with methylene blue extending from one mastoid tip to the other (see Fig. 11). The vertical arm extends along the posterior border of the sternocleidomastoid muscle while the horizontal part of the U is approximately one finger breadth above the suprasternal notch and the clavicle. A small tongue of skin may be made at the lowermost border to aid in making a tracheal stoma.

The skin flap is elevated from below until the body of the hyoid is exposed (see Fig. 12). At the inferior and lateral border of the incision the skin is undermined for a short distance. The superficial fascia is cut horizontally over the area of the tracheal stoma, the anterior and external jugular

Fig. 11. Outline for skin incision.

Fig. 12. The skin flap is elevated. Scm—sternocleidomastoid; AJ—anterior jugular vein.

veins are clamped, cut and ligated. The sternohyoid and sternothyroid muscles are divided on each side and tied at a distance of 1.5 to 2 cm. above the sternal attachment (see Fig. 13).

There may be some question as to involvement of the thyroid gland when it is placed over the thyroid or cricoid cartilage; for example, in subglottic carcinoma. If the isthmus is at or above the first tracheal ring, the isthmus and/or one homolateral lobe of the thyroid is resected with the larynx.

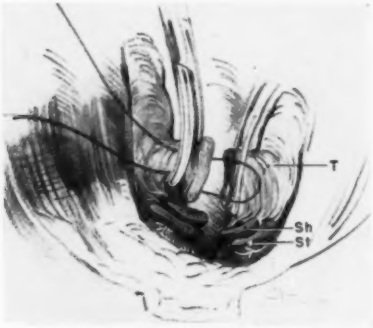

Fig. 13. The thyroid isthmus is divided. Infrahyoid muscles are divided and ligated. T—thyroid; Sh—sternohyoid; St—sternothyroid.

In the event that the isthmus of the thyroid is low over the trachea and is uninvolved, the isthmus is clamped, divided and sutured (see Fig. 13). The tracheal surface of each lobe is separated from the trachea. Extreme care is taken not to free the posterior margin of the thyroid gland or cut the inferior thyroid artery or vein. All areolar tissue anteriorly in the space of Burns and lateral to the tracheal stump is dissected from the tracheal rings and left attached to the anterior and lateral part of the first tracheal ring.

Several drops of 10 per cent cocaine are next instilled into the trachea. The trachea is opened horizontally between the first and second tracheal rings. A flap of mucous membrane from the posterior surface of the tracheal wall is fashioned

except in any subglottic extension. The flap from the posterior trachea is closed with the tongue of skin flap at the end of the operation. Separation of the tracheal stoma from the esophagus is to be avoided because of the creation of dead space. The tracheal stoma is anchored with heavy braided silk and buttons and endotracheal anesthesia is started (see Fig. 14).

Fig. 14. Fixation of the tracheal stoma. T—thyroid; Sh—sternohyoid; St—sternothyroid.

The extent of the laryngeal lesion is now determined through the open trachea. The decision of bilateral neck dissection is made at this time. In a unilateral lesion, one exposes and looks for questionable glands in the opposite carotid sheath. If any are found, bilateral neck dissection is performed.

Since in most instances glands are not found, from the side of the larynx *opposite* the location of the tumor, dissection is carried along the anterior border of the sternocleidomastoid muscle inferiorly, superiorly and posteriorly until the crico-

pharyngeus muscle is exposed. The superior thyroid vessels are clamped and tied close to the thyroid gland. The omohyoid muscle is clamped, cut and ligated. Separation of the larynx from the esophagus is carried up to the area of the arytenoid. The arytenoid cartilage must not be exposed or the pharynx entered. This avoids accidental dissection into the tumor. The cricopharyngeus muscle on the uninvolved side is clamped and cut posteriorly to the inferior and superior cornu of the thyroid cartilage (see Fig. 15).

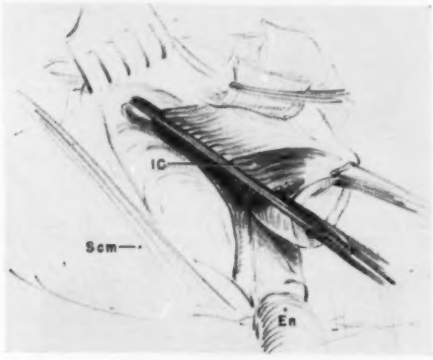

Fig. 15. Mobilization of the larynx and division of inferior constrictors on the uninvolved side. IC—inferior constrictors; Scm—sternocleidomastoid.

The cut muscle is not sutured. The superior cornu of the thyroid is isolated, dissected free of the perichondrium close to the base of the lamina and is removed (see Fig. 16). With a cautery knife, the superior border of the body of the hyoid bone is outlined, separated from the suprahyoid muscles and isolated from the greater cornu of the uninvolved side to the lesser cornu of the involved side (see Fig. 17). Dissection is carried into the vallecula, but the pharynx should not be opened. The procedure is facilitated if a tenaculum is placed on the body of the hyoid for traction.

In exposing the greater cornu of the hyoid the anterior jugular veins must be isolated, cut and tied (see Fig. 18). The superior laryngeal artery and vein will next be identified,

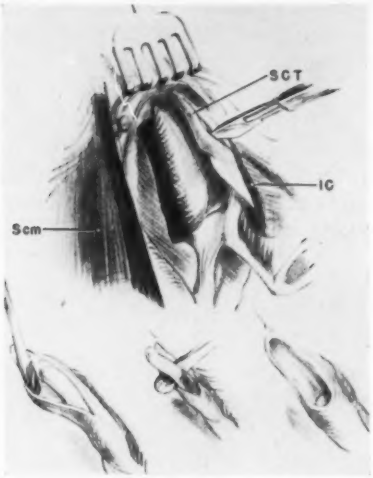

Fig. 16. Removal of superior cornu of thyroid cartilage. SCT—superior cornu of thyroid; Scm—sternocleidomastoid; IC—inferior constrictors.

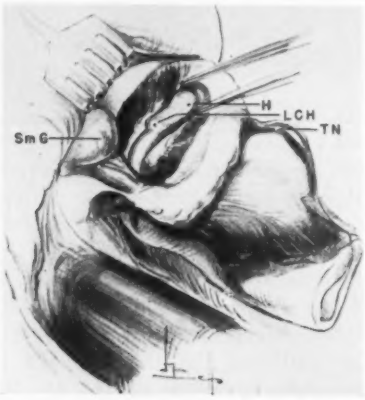

Fig. 17. Separation of suprahyoid muscles from lesser cornu of involved side to greater cornu of uninvolved side of hyoid. H—hyoid; LCH—lesser cornu of hyoid; TN—thyroid notch; SmG—submaxillary gland.

cut and ligated before they pierce the thyrohyoid membrane. On the side away from the tumor the greater cornu of the

hyoid bone is next released from its periosteal bed by incising and dissecting it away from the periosteum with a sharp elevator and scissors (see Fig. 19).

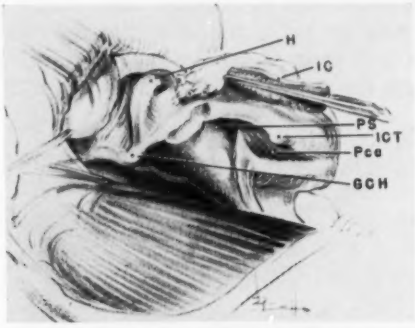

Fig. 18. Pyriform sinus is exposed by rotating larynx towards involved side. H—hyoid; IC—inferior constrictors; PS—pyriform sinus; ICT—inferior cornu thyroid; Pca—posterior cricoarytenoid; GCH—greater cornu hyoid.

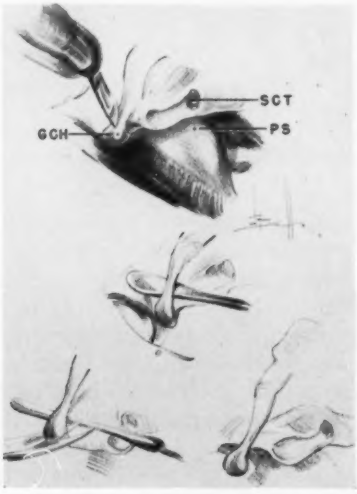

Fig. 19. Greater cornu of hyoid is released from its periosteal bed. GCH—greater cornu hyoid; SCT—superior cornu thyroid (perichondrial bed); PS—pyriform sinus.

With the larynx retracted and rotated towards the side of the tumor, the pyriform sinus is opened on the uninvolved side and the opening is enlarged, allowing direct inspection of the larynx proper and of the opposite pyriform sinus (see Fig. 20). A tenaculum is inserted from below through the larynx, grasping the tip of the epiglottis and clearly exposing the vallecula and base of the tongue (see Fig. 21). Where tumor involves the glottis, it is better to place the tenaculum

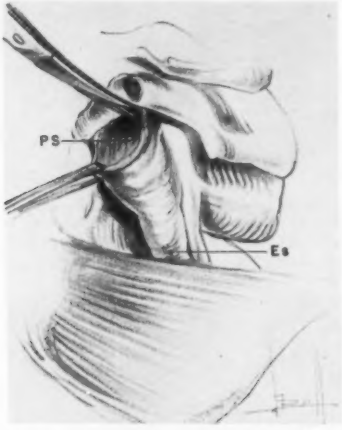

Fig. 20. Pyriform sinus is opened on uninvolved side. PS—pyriform sinus; Es—esophagus.

through the opening in the pyriform sinus. With scissors, the opening of the pyriform sinus is enlarged by cutting across the base of the tongue, close to the epiglottis and aryepiglottic fold as well as posteriorly and inferiorly to the arytenoid (see Fig. 21). By opening the pharynx in this fashion, the larynx may be rotated over to the side of the tumor and the margin of the tumor clearly defined. There should be 2 to 2.5 cm. of normal mucosa beyond the apparent limits of the tumor. Dissection is now carried upwards along the posterior lateral wall of the hypopharynx. On one side will be the larynx, the cut margin of the pyriform sinus with the lateral hypopharynx above it. On the other side will be the margin of the

Fig. 21. Pharyngeal stoma is enlarged by cutting posterior and inferior to the arytenoids, and along the aryepiglottic fold and into the vallecula of the uninvolved side. E—epiglottis; A—arytenoid; Es—esophagus; En—endotracheal tube.

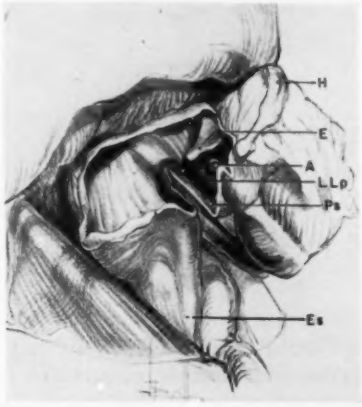

Fig. 22. Further separation of pharyngeal stoma from larynx and pyriform sinus. E—epiglottis; A—arytenoid; Llp—lateral laryngopharynx; PS—pyriform sinus.

normal posterior hypopharyngeal mucous membrane (see Fig. 22). In so turning the larynx, the greater cornu of the hyoid and the thyroid lamina will mound into the pharynx and will serve as a landmark (see Fig. 22). The dotted line (see Fig. 23) indicates where the final separation of the larynx from the base of the tongue will be completed.

To facilitate closure of the stoma, the cut edge of the hypopharyngeal mucosa is undermined (see Fig. 24). A nasal feeding tube is put in place. Using Dulox 000 chromic catgut, the stoma is closed by inverting its mucous membrane margins. The corners or sutures are left long for landmarks (see Fig. 25). Fig. 26 shows the pharynx closed.

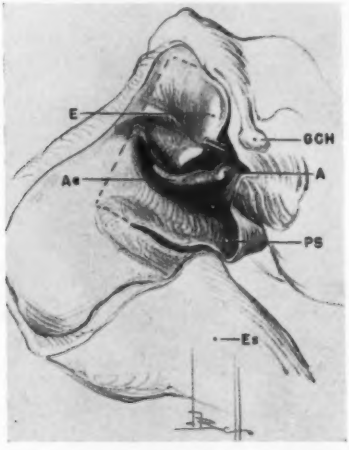

Fig. 23. Outline of incision for complete separation of larynx from pharynx. E—epiglottis; GCH—greater cornu hyoid; Ae—aryepiglottic fold; A—arytenoid; PS—pyriform sinus; Es—esophagus.

The radical neck dissection is now started (see Fig. 26). The larynx is wrapped in gauze. The sternal and clavicular heads of the sternocleidomastoid muscle are cut 2 cm. from their attachments and sutured. The omohyoid muscle is divided laterally and sutured (see Fig. 27). The internal jugular vein is isolated low in the neck and separated from the

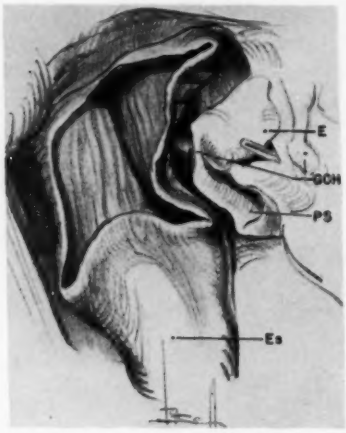

Fig. 24. Pharyngeal stoma to be closed. E—epiglottis; GCH—greater cornu hyoid; PS—pyriform sinus; Es—esophagus.

Fig. 25. Closure of pharyngeal stoma. N—nasal feeding tube; IC—inferior constrictors; En—endotracheal tube.

carotid artery and the vagus nerve, doubly tied and transfixed. On the left side of the neck great care must be exercised not to injure the thoracic duct. The thoracic duct empties into

Fig. 26. Pharynx closed. Smg—submaxillary gland; GCH—greater cornu hyoid; E—epiglottis; SCT—superior cornu thyroid; PS—pyriform sinus; IC—inferior constrictors (cut partially).

Fig. 27. Radical neck dissection is started. Sternocleidomastoid muscle is divided and ligated. L—larynx (wrapped in gauze); IJ—internal jugular vein; T — thyroid; Es — esophagus; Scm — sternocleidomastoid; St—sternothyroid; Sh—sternohyoid.

the subclavian vein close to the internal jugular vein. The internal jugular vein is dissected superiorly. When the carotid sheath is opened the vagus nerve is seen lateral to the

carotid artery (see Fig. 28). As one dissects upwards over the lateral lobe of the thyroid, the superior thyroid artery and vein may be ligated. Dissection over the carotid is carried up to the bifurcation. In the event that a metastatic mass has occluded the common or internal carotid artery, the entire vessel should be sacrificed. Hemiplegia should not result. The cricopharyngeus muscle on the involved side should be cut

Fig. 28. Internal jugular vein is ligated and the carotid sheath is opened. IJ—internal jugular vein; C—carotid artery; V—vagus; T—thyroid; Es—esophagus.

posteriorly to the inferior cornu and the thyroid lamina. All areolar tissue overlying the prevertebral fascia is dissected from beneath the clavicle and laterally into the posterior triangle and reflected superiorly (see Fig. 29).

Dissection of the areolar tissue is carried laterally until the anterior border of the trapezius muscle is reached. At this point dissection is carried superiorly along its anterior border; the spinal accessory nerve may be identified near the junction at the lower and middle one-third (see Fig. 30).

Fig. 29. Dissection laterally into the posterior triangle. O—omohyoid muscle; AT—areolar tissue; V—vagus; C—carotid artery; IJ—internal jugular vein.

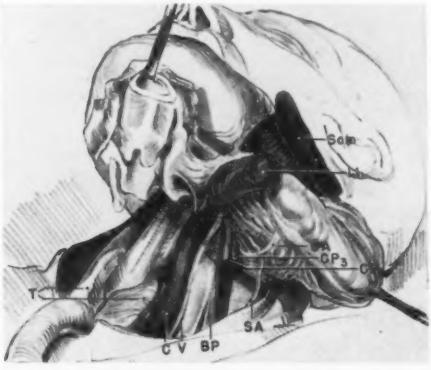

Fig. 30. Dissection superiorly with division of the cervical plexus. Identification of the spinal accessory nerve. Scm — sternocleidomastoid; GA — greater auricular nerve; CP_3—cervical plexus III; CP_4 cervical plexus IV; SA—spinal accessory; BP—brachial plexus; T—thyroid; C—carotid artery.

Gentle pinching of this nerve with a smooth tip forceps will affect contraction of the shoulder. In dissecting superiorly, anterior cervical rami 4, then rami C3, will be seen to enter the areolar tissue just lateral, posterior and inferior to the carotid bifurcation. These are the cervical cutaneous sensory nerves and must be sectioned.

Fig. 31. Submental triangle is exposed. Anterior belly of digastric muscle is divided. R—ramus of mandible; D—digastric; M—mylohyoid muscle; S—submental fat; Scm—sternocleidomastoid.

The spinal accessory nerve will perforate the sternocleidomastoid muscle at the junction of the upper and middle one-thirds on its posterior and inferior border on its way to the trapezius. Often a sensory branch from C3 will anastomose with the spinal accessory at this point. The greater auricular nerve which curves around the posterior border of the sternocleidomastoid muscle is resected. The spinal accessory nerve must be dissected free and allowed to drop posteriorly by cutting the fibres of the sternomastoid muscle. In the event that the spinal accessory nerve runs through or adjacent to ques-

tionable or positive nodes, it must be sacrificed. As one dissects superiorly the spinal accessory nerve will be seen to be just lateral to the internal jugular vein.

In the submental space areolar tissue is dissected down to the mylohyoid muscle and reflected laterally along the ramus of the mandible (see Fig. 31). The anterior belly of the digastric muscle is identified, clamped, sectioned and tied (see Fig. 32). The submaxillary gland and lymph nodes are reflected laterally and the duct of the submaxillary gland turning behind the mylohyoid muscle is ligated and cut. The facial artery and vein are identified at the ramus of the mandible, clamped, cut and tied (see Fig. 33). The lingual nerve is close to the submaxillary duct and should be preserved.

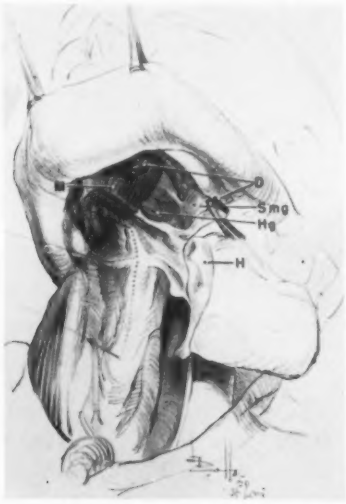

Fig. 32. Submaxillary gland is separated to where its duct turns behind the mylohyoid muscle. D—digastric; Smg—submaxillary gland; Hg—hyoglossus; H—hyoid.

The lower figure (see Fig. 33) shows the hypoglossal nerve as it is ideally visualized. It is more frequently not seen in this area, because after releasing the suprahyoid muscles from

the hyoid bone, usual anatomical landmarks are lost. The nerve will be easily cut on further lateral dissection. For this reason dissection is now carried superiorly from below. The superior thyroid artery will be identified as the first branch of the external carotid artery. This should be cut and doubly

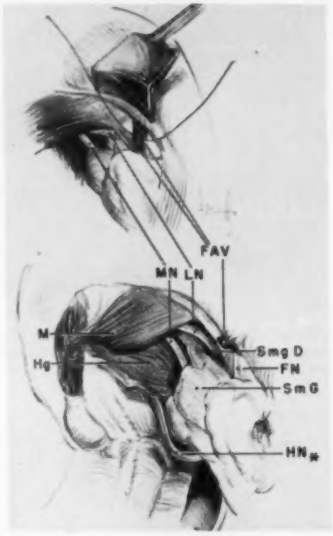

Fig. 33. Submaxillary gland area. FAV—facial artery vein; LN—lingual nerve; MN—mylohyoid nerve; M—mylohyoid; Hg—hyoglossus; Smg D—submaxillary gland duct; HN*—hypoglossal nerve (usually not visualized).

ligated (see Fig. 34). The hypoglossal nerve can be seen to arise between the internal and external carotid artery (see Fig. 35), crossing over the latter and following the course of the lingual artery to enter the tongue between the mylohyoid and the hyoglossus muscles (see Fig. 36). The hypoglossal nerve is freed along its entire course and allowed to drop into its new position. The XIIth nerve is sacrificed if it is adjacent to or involved with questionable or positive nodes.

In dissecting posteriorly at the angle of the mandible the tail of the parotid gland is cut (see Fig. 36). The cervicomaxillary branch of the facial nerve is sometimes sectioned,

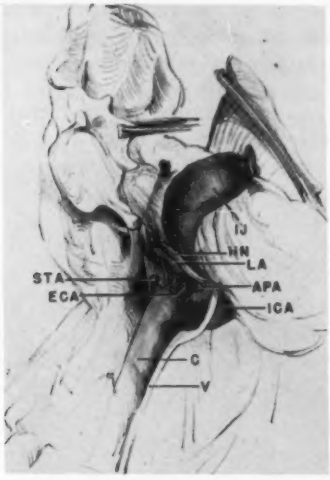

Fig. 34. Relationships of hypoglossal nerve. HN—hypoglossal nerve; LA—lingual artery; STA—superior thyroid artery; ECA—external carotid artery; APA—ascending pharyngeal artery; IJ—internal jugular vein.

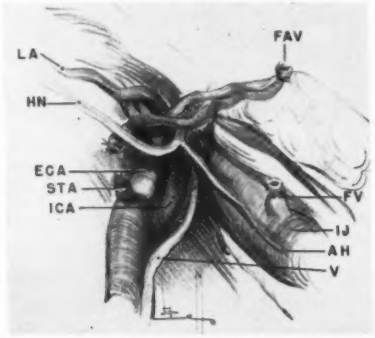

Fig. 35. Relationships at bifurcation of carotid artery. LA—lingual artery; FAV—facial artery vein; HN—hypoglossal nerve; ECA—external carotid artery; STA—superior thyroid artery; ICA—internal carotid artery; FV—facial vein; IJ—internal jugular vein; AH—ansa hypoglossal; V—vagus.

as it may extend as low as one inch below the angle of the jaw. The facial artery is doubly ligated at its origin. The internal jugular vein is separated and doubly ligated and

Fig. 36. Isolation of hypoglossal nerve and division of the tail of parotid gland. M—mylohyoid; FN—facial nerve (cervicomaxillary); Hg—hyoglossus; P—parotid gland; HN—hypoglossal nerve; Scm—sternocleidomastoid.

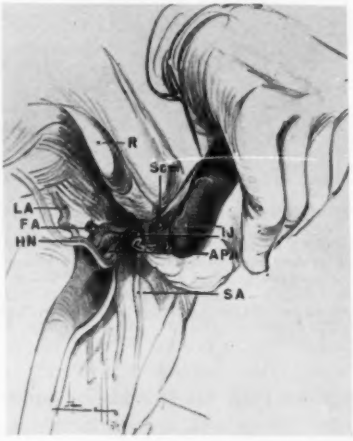

Fig. 37. Ligation of internal jugular vein under the jugular foramen. R—ramus of mandible; LA—lingual artery; FA—facial artery; HN—hypoglossal nerve; IJ—internal jugular vein; SA—spinal accessory.

transfixed beneath the jugular foramen (see Fig. 37). Finally, the sternocleidomastoid is sectioned close to the mastoid attachments, as are the lesser muscle groups; that is, the digastric and the stylohyoid muscles. The final anatomical structures visualized at the end of the operation are illustrated in Fig. 38. If a bilateral neck dissection is indicated at one stage, a neck dissection with removal of areolar tissue and lymph nodes with preservation of the internal jugular vein is performed. Block dissection is completed, followed by a laryngectomy and complete neck dissection with removal of

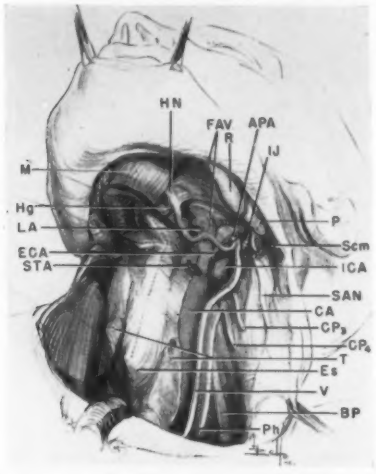

Fig. 38. Anatomy of completed laryngectomy and radical neck dissection. STA—superior thyroid artery; ECA—external carotid artery; LA—lingual artery; Hg — hyoglossus muscle; M — mylohyoid muscle; HN — hypoglossal nerve; FAV—facial artery and vein; R—ramus of mandible; APA—ascending pharyngeal artery; IJ—internal jugular vein; P—parotid; Scm—sternocleidomastoid muscle; ICA—internal carotid artery; SAN—spinal accessory nerve; CA—common carotid artery; CP_3—cervical plexus III; CP_4—cervical plexus IV; T—thyroid; Es—esophagus; BP—brachial plexus; Ph—phrenic nerve.

the internal jugular vein on the major side. Both internal jugular veins can be excised at one time. An alternative is to delay neck dissection six to eight weeks as a second stage after combined laryngectomy and neck dissection. The re-

maining jugular vein can be removed. This is possible at this time because of the establishment of collateral circulation.

The pharynx is reinforced with two rows of interrupted silk sutures. The cricopharyngeus muscles are overlapped and the two thyroid lobes may be sutured together. The wound is thoroughly irrigated with warm saline solution. The skin margin is closed with interrupted subcutaneous and fine black silk. Two Penrose drains are placed through a stab wound, lateral to the lower incision. The tracheal stoma is placed so that the tongue of skin is approximated to the posterior wall of the trachea.

A tight bandage is applied with mechanic's waste and reinforced with elastoplast. Two to three units of blood are usually given during the operation. Chemotherapy and antibiotics are given for one week. A high protein, high caloric tube feeding is given for one week. It is important that the patient be asked not to swallow saliva and other secretions for one week. Sips of water may be tried by mouth on the eighth day. If there is no leakage, feeding by mouth may be started at the end of the eighth day and the nasal feeding tube removed. If leakage occurs, parenteral or tube feeding should be given until the fistula has closed.

DISCUSSION OF CASES.

In our series, radical neck dissection and laryngectomy was performed in 37 patients. Ten patients were done in two stages and 27 patients in one stage. A brief summary of each case, nodal findings and results to date are summarized in Tables I, II, III and IV.

One-Stage. Twenty-seven consecutive patients considered operable had combined laryngectomy and radical neck dissection. These patients may be further divided into those with positive nodes, those with enlarged palpable nodes, and those without palpable nodes. There was no immediate postoperative mortality. One died of cardiac and pulmonary complications at the end of the fifth week. Twenty are living, well and

free of disease. Three cases with recurrent carcinoma are "controlled" by irradiation. To date, contralateral cervical metastases have not appeared in any instance where the lesion was unilateral.

Six patients clinically showed positive nodes at the time of surgery. Of these, two are living and well to date. Two cases known to have a small metastasis, in the anterior superior mediastinum at surgery but not seen by X-ray, received heavy postoperative irradiation. One patient died seven months later from a second primary carcinoma.

Three patients present enlarged palpable nodes not characteristic of carcinoma, on the same side as the primary lesion.

TABLE I

							CASE STUDY					
NO.	INITIALS	AGE	SEX	COLOR	UNIL. OR BIL.	DATE	LOCATION LESION	GRADE	NODES. CLIN.	MICROS. NODES	STATUS	DATE
1.	J.B.*	64	M	W	UNIL.	9/47	Left, False True, Subg. Pyriform	3	Neg.	Pos.	D.	1 year Broncho Pneumonia
2.	H.W.	65	M	C	UNIL.	3/48	Left, True False, Subg. Vent.	2	Neg.	Neg.	A.	
3.	E.K.*	54	M	W	UNIL.	8/48	Rt. Arytenoid Pyriform Lateral Wall Pharynx	3	Neg.	Neg.	A.	
4.	G.T.	23	M	W	UNIL.	1/49	Rt. False Vent. True	3	Pos.	Pos.	A.	
5.	M.G.*	53	M	W	BIL.	4/49	Rt. and Lt. False, True Vent. Subg.	2	Neg.	Pos.	A.	Recurrence in Thyroid
6.	C.S.	65	M	W	UNIL.	10/49	Rt. False, True Epig. Ary-Epig.	2	Neg.	Neg.	A.	
7.	A.P.	67	M	W.	UNIL.	11/49	Rt. False Vent. True	2	TPos.	Neg.	A.	
8.	B.R.	66	M	W	UNIL.	1/50	Rt. False True, Vent.	2	Neg.	Neg.	A.	
9.	G.S.	68	M	W	UNIL.	2/50	Rt. False True, Ary-epig.	3	Neg.	Neg.	A.	
10.	E.S.	59	M	W	UNIL.	3/50	Lt. Cord Vent.	2	Neg.	Neg.	A.	
11.	G.M.	65	M	C	UNIL.	3/50	Lt. Cord Subg.	2	Neg.	Pos.	A.	
12.	J.K.	54	M	W	UNIL.	3/50	Lt. Pyriform Arytenoid	3	Pos.	Pos.	A.	Recurrence Lt. Neck
13.	J.L.	61	M	W	UNIL.	5/50	Rt. Cord Subg.	Adeno Ca.	Pos.	Pos.	D.	5 weeks Post-op.

TABLE I (CONTINUED)

NO.	INITIALS	AGE	SEX	COLOR	UNIL. OR BIL.	DATE	LOCATION LESION	GRADE	NODES CLIN.	MICROS. NODES	STATUS	DATE.
14.	J.W.	64	M	W	UNIL.	6/50	Rt.False, True Cord Vent.	3	Neg.	Neg.	A.	
15.	B.P.	66	M	W	UNIL.	8/50	Rt.Ary-Epig. Pyriform Arytenoid	3	Pos.	Pos.	A.	
16.	P.H.	58	M	W	UNIL.	8/50	Rt.False, Vent.True	3	Neg.	Pos.	A.	
17.	J.B.	60	M	W	UNIL.	11/50	Rt.Ary-Epig. Pyriform base Epig.False,Ary.	3	Pos.	Pos.	A.	Recurrence in neck ?Mediastinum
18.	E.M.*	30	M	W	UNIL.	12/50	Rt.False,True Subgl.Base Epig.	4	Neg.	Neg.	A.	
19.	W.M.	62	M	W	UNIL.	3/51	Lt.True Subgl.	3	Neg.	Neg.	A.	
20.	C.L.*	60	M	W	UNIL.	4/51	Lt.Pyriform Arytenoid	3	Pos.	Pos.	D.	Second Primary Carcinoma
21.	J.K.	64	M	W	UNIL.	5/51	Lt.Vent. True Cord	3	?Pos.	Neg.	A.	
22.	L.E.	51	M	W	UNIL.	5/51	Rt.Cord Subglottic	2	Neg.	Pos.	A.	
23.	M.A.	69	M	C	UNIL.	5/51	Rt.Ary-Epig. Arytenoid	3	?Pos.	Pos.	D.	Second Primary Carcinoma
24.	P.A.	66	M	W	UNIL.	5/51	Lt.Ary-Epig. False,Arytenoid	2	Neg.	Neg.	A.	
25.	C.C.	49	M	W	UNIL.	5/51	Lt.Subglottic	3	Neg.	Neg.	A.	
26.	F.R.	56	M	W	UNIL.	5/51	Lt.Subglottic True,Vent.	3	Neg.	Pos.	A.	
27.	E.K.	61	M	W	UNIL.	6/51	Lt.Subglottic True Cord	2	Neg.	Pos.	A.	

* ROENTGEN THERAPY PRIOR TO SURGERY

Two are well at the present time. In the remaining patient metastatic carcinoma was found in a single node. This patient later died of a second primary carcinoma.

Eighteen consecutive cases with advanced carcinoma without palpable nodes had prophylactic radical neck dissection. Seven of these had microscopic metastases in the cervical lymph nodes. Microscopic positive nodes were found in six out of 15 instances of subglottic and endolaryngeal carcinoma. The remaining one of the three occurred with extrinsic carcinoma. In five of the seven specimens a solitary soft node, less

TABLE II

TWO STAGES

NO.	INITIALS	AGE	SEX	COLOR	UNIL. OR BIL.	DATE	LOCATION LESION	GRADE	NODES CLIN.	MICROS. NODES	STATUS	DATE
1.	C.K.	60	M	W	UNIL.	L.5/44 ND.2/49	True,Vent. Rt.False	2	Neg→Pos	Pos.	A.	
2.	C.H.	49	M	W	UNIL.	L.5/44 ND.7/48	Cord Fixed Rt.True	2	Neg→Pos	Pos.	D.	2½ years Recurrence
3.	A.R.	60	M	W	UNIL.	L.6/47 ND.9/48	True,Vent. Lt.False	2	Neg→Pos	Pos.	D.	3 years Recurrence
4.	H.C.	56	M	W	UNIL.	L.11/47 (ND)11/47	Lt.Arytenoid Pyriform	3	Pos.	Pos.	D.	1 year Recurrence
5.	P.S.	67	M	W	UNIL.	L.11/47 (ND)12/47	Rt.Ary-Epig. False,True Subg.	3	Pos	Pos.	D.	8 months Recurrence
6.	P.R.	63	M	W	UNIL.	L.12/47 (ND)12/47	Rt.Arytenoid Pyriform	3	Pos.	Pos.	D.	2½ years Recurrence
7.	H.S.	67	M	W.	BIL.	L.1/48 (ND)2/48	Ary-Epig. Subg.	2	?Pos.	Neg.	A.	
8.	C.S.	66	M	W	UNIL.	L.7/48 ND.6/49	Rt.False Vent.	2	Neg→Pos	Pos.	D.	2½ years Recurrence
9.	J.E.	41	M	C	UNIL.	L.12/48 ND.1/49	Rt.False True Subg.	2	?Pos.	Neg.	A.	
10.	J.C.	67	M	W	UNIL.	(ND)5/49 L.6/49	Rt.Arytenoid Pyriform	3	Pos.	Pos.	D.	5 months Recurrence

L. Laryngectomy

ND. Neck Dissection

(ND) Neck Dissection Delayed

TABLE III
SUMMARY OF ONE- AND TWO-STAGE CASES

Total		37
Two stages	10	
Neck dissection two weeks after laryngectomy	4	
Neck dissection late after laryngectomy	4	
Neck dissection two weeks after laryngectomy, enlarged palpable nodes, negative microscopic; bilateral neck dissection (1)	2	
Prophylactic neck dissection	0	
One stage		27
Neck dissection with laryngectomy, positive nodes	6	
Neck dissection with laryngectomy, enlarged palpable nodes, positive microscopic	1	
Neck dissection with laryngectomy, enlarged palpable nodes, negative microscopic	2	
Prophylactic neck dissection with laryngectomy		18
Negative microscopic	11	
Positive microscopic	7	
Bilateral neck dissection (1)		

TABLE IV
RESULTS

Postoperative mortality, immediate	0
Postoperative mortality, end of fifth week	1
Late mortality	
Local recurrences (two stages)	7
Bronchopneumonia (one stage)	1
Second prmary carcinoma (one stage)	2
Clinically controlled	
Living with no recurrence (two stages)	3
Living with no recurrence (one stage)	20
Positive node cases	2
Enlarged palpable node cases	2
Prophylactic neck dissection cases	16
Living and "controlled" with irradiation (one stage)	
Recurrent in neck (positive node cases)	2
Recurrent in thyroid	1

than a centimeter in its greatest length, showed microscopic carcinoma in the peripheral sinusoid. In two specimens a single node measuring 1.5 cm. felt questionably firmer than usual. Sixteen patients are free of disease. One patient who later developed a recurrence in the thyroid gland is now "controlled" by irradiation. Another patient died a year later from bronchopneumonia.

Five patients had combined neck dissection and laryngectomy following completion of X-ray therapy. In these instances, the lesions were very advanced and residual tumor remained after irradiation therapy. In three of the five, tumor was found in the nodes in spite of external irradiation. Three of the five are free from disease at the present time.

Except for eight cases which developed temporary pharyngeal fistula, all healed within a two weeks' postoperative period. Of these fistulae, five closed within three weeks and three persisted for four weeks (received preoperative X-ray therapy). Permanent fistula did not occur in any instance, and secondary repair of a fistula was not necessary.

A good esophageal voice was obtained in 75 per cent of the cases and nearly all could do without a tracheotomy tube after three months. The cosmetic result and specimen are illustrated in Figs. 39, 40, 41 and 42.

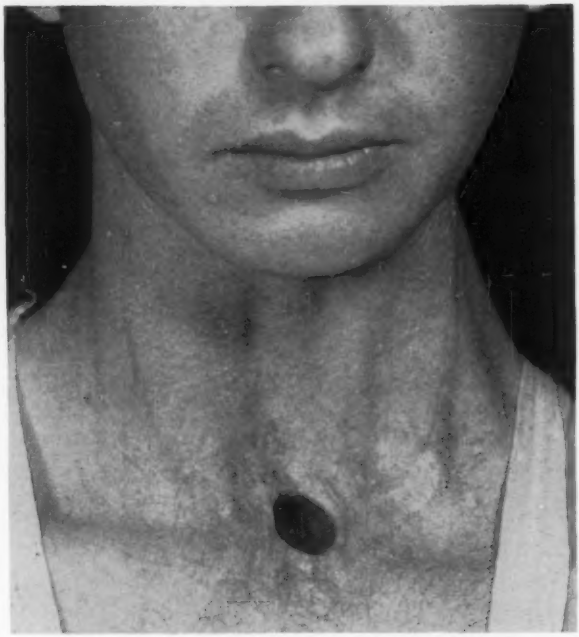

Fig. 39. Patient No. 1. Postoperative laryngectomy and radical neck dissection.

Two-Stage. In the presence of positive nodes, radical neck dissection was delayed one to two weeks after laryngectomy in four instances. All four patients eventually died with local recurrences, in spite of heavy postoperative irradiation. In one instance, the tumor recurred in the interval between the neck dissection and laryngectomy and eroded the transverse process of the vertebrae.

Two patients are clinically well where neck dissection was delayed for enlarged palpable nodes which were microscopically negative.

Delayed radical neck dissection was performed in four patients where metastatic nodes appeared late. Subsequently, three of the four died with mediastinal extension and local

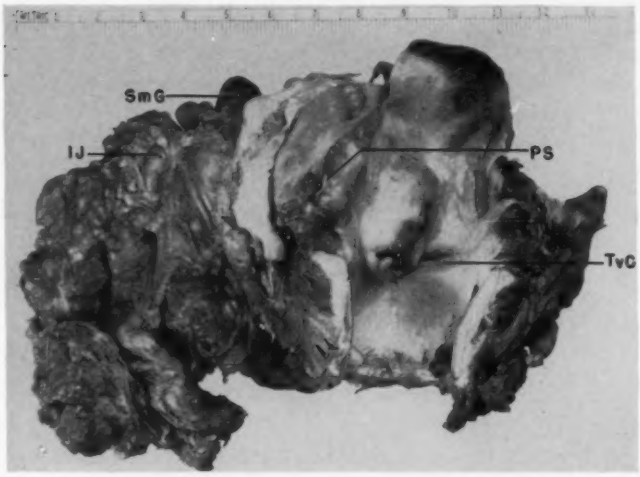

Fig. 40. Specimen of Patient No. 1. TvC—true vocal cord; PS—pyriform sinus.

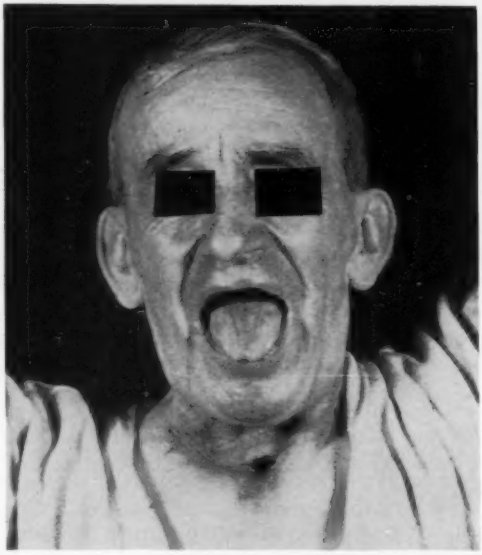

Fig. 41. Patient No. 2. Postoperative functional result.

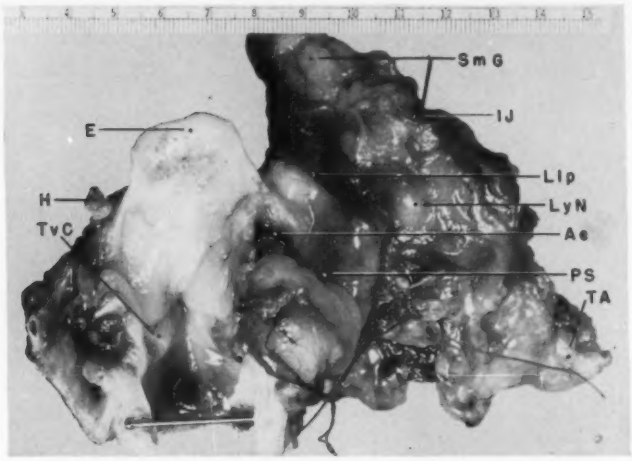

Fig. 42. Specimen of Patient No. 2. E—epiglottis; H—hyoid; TvC—true vocal cord; SmG—submaxillary gland; LIp—lateral laryngopharynx; LyN—lymph node (positive); Ae — aryepiglottic fold carcinoma; PS — pyriform sinus; TA—areolar tissue.

recurrences. Contralateral cervical metastases did not occur in any instance. Only one case remained clinically well where late nodal metastases were removed by radical neck dissection.

DISCUSSION.

It is emphasized that combined radical neck dissection and laryngectomy for advanced carcinoma of the larynx is advocated at the first surgical excision. Neck dissection is considered "therapeutic" when associated with metastatic cervical nodes or with palpable enlarged nodes not characteristic of carcinoma.

The technique proposed is not only ideal for subglottic, ventricular, and false cord carcinoma, but it has been extended to include carcinoma of the aryepiglottic fold and of the pyriform sinus.

Dividing the operation into two stages will cut involved lymphatic pathways, which is contrary to sound surgical prin-

ciples. The two-stage operation has given poor results. All four patients treated in this manner eventually died with local recurrence and mediastinal extension. Only one patient out of four is living and free from recurrence when neck dissection was performed for clinically positive nodes late after laryngectomy.

A number of instances of laryngeal carcinoma is handled by less radical surgical measures. A widefield laryngectomy alone will be sufficient where laryngofissure or other intralaryngeal methods are not applicable. Neck dissection is omitted since it is a well known fact that cervical lymph node metastases occur very rarely under these circumstances.

Combined prophylactic neck dissection and widefield laryngectomy is advocated where the primary tumor involves the rich lymphatic areas. It has been demonstrated that in advanced carcinoma of the larynx microscopic metastases exist frequently in impalpable nodes. The combined operation is performed when the vocal cord is fixed, or when carcinoma involves the subglottic, ventricular or false cord areas. The procedure has been extended to include carcinoma of the aryepiglottic fold and pyriform sinus where cordal fixation or arytenoid edema is present. Bilateral prophylactic neck dissection with laryngectomy is performed when the lesion is very advanced and on both sides of the larynx, or if questionable nodes are found contralateral to a unilateral lesion.

There can be little question that neck dissection performed in the one-stage operation will result in more cures when metastases are clinically impalpable than when surgery is performed in the presence of palpable metastatic nodes, or in two stages after the appearance of late metastatic nodes. The end-results of radical surgery in carcinoma of the breast shows the cure rate is the highest where there is no metastasis present, less with microscopic metastases, and least where palpable adenopathy is present.[1] Even in the last group surgery will give the best results rather than radiation. In our series where the combined operation was performed in the absence of palpable nodes, pathologic examination of the cer-

vical lymphatics showed microscopic carcinoma in one or more nodes in seven out of 18 patients (six out of 15 instances of subglottic and endolaryngeal carcinoma, or 40 per cent). Since Saphir[49] has shown that the percentage of microscopic metastases can be increased by serial section of previously reported "negative nodes," the percentage of microscopic metastases should be even higher than 38.8 per cent. It has not been our standard practice to serially section every node removed from the neck dissection.

As mentioned previously, most of the microscopic metastases occurred in soft nodes under 1 cm. It is impossible to palpate such a small soft node or even a questionable node, measuring 1 cm. or slightly larger, in a muscular neck or low under the sternocleidomastoid muscle.

To explore the carotid sheath for a questionable node is of some value, but to perform frozen sections of a node before neck dissection has not always been reliable; furthermore, from our experience one cannot always predict which node will be involved. A microscopic metastasis from subglottic carcinoma may be present in a jugulodigastric node, mid-deep cervical node or in one low in the neck. For those who oppose prophylactic neck dissection on the premise that two needless neck dissections were done to benefit one, there is no certain method other than radical surgery at the present time to determine which one out of the three harbors the metastasis.

It has been mentioned previously that many radiologists maintain that metastatic carcinoma is seldom cured by irradiation. On the other hand, others have stated that radiation can cure a small metastatic node. One often fails, however, to cure multiple impalpable nodes when irradiation is directed over a metastatic node through a small port. Neck dissection may succeed more often in such situations, particularly since block dissection can cover the clavicle to the mandible, whereas irradiation therapy in cancer-lethal doses over such a large area could not possibly be tolerated by the patient. Postoperative irradiation is reserved only for those patients where there is a question as to the surgical margin of safety. For

example, if the lowermost node in the neck dissection is positive, radiation is directed over the superior mediastinum. Irradiation therapy is given with the hope that a small metastasis may be cured, whereas a large one never will be.

Radiation therapy is indicated where an extensive anaplastic carcinoma precludes surgery. If after maximum irradiation, the lesion is still present, though much decreased in size, radical surgery *may* be of value. Surgery will be most difficult under these circumstances.

The postoperative mortality of the extended procedure is low. If we consider a two-week postoperative period, the mortality for laryngectomy is as low as 1.5 per cent.[42] When one included extrinsic carcinoma, the mortality rate was in the neighborhood of 15 per cent.[27] To date, we have had no deaths within this period, and only one at the end of the fifth week. If this case is included, the mortality is 3.7 per cent. Many of our patients were bad risks from a medical standpoint. It is important to emphasize that seldom were our patients excluded because of medical risk. Unless the patient is so debilitated or his cardiorespiratory reserve is so poor that even with medical management he cannot tolerate anesthesia or an operation, there can be few medical contraindications to surgery where there is a possibility of curing cancer.

The technique allows direct inspections of the tumor from below, through the trachea, and through the uninvolved pyriform sinus before neck dissection is attempted. If the condition of the patient during the operation changes, necessitating division of surgery into two stages, this method is advantageous because at least the primary lesion has been removed. If, on the other hand, neck dissection is done first, the primary would have to be removed at another operation. The latter situation is worse because the lymphatic pathways will open directly into the neck wound. In performing the radical neck dissection, the XIth and XIIth nerves are sacrificed if they are immediately adjacent to/or involved by questionable or positive nodes. The nerve should be preserved whenever possible because shoulder drop and pain sometimes is very handicapping.

Esophageal voice is possible in most instances and permanent pharyngeal fistula did not occur in any of our cases. The cosmetic result, tracheal stoma and physiology is as good as in the one-stage radical procedure as for a laryngectomy alone.

The authors are aware that it is still too early to evaluate this method of therapy on a five-year basis. The fact remains that in consecutive cases a significant percentage of microscopic metastases has been demonstrated to exist in impalpable nodes. This would suggest that if we are to improve the care rate, serious consideration should be given to routine prophylactic neck dissections with laryngectomy in those lesions where metastases are likely to occur.

SUMMARY.

1. The indication, limitations and technique for a one-stage laryngectomy and radical neck dissection are presented for the treatment of carcinoma of the larynx. The method described allows a very wide excision of the primary lesion and of the cervical lymph nodes without cutting across the lymphatic pedicles.

2. The time to treat advanced laryngeal carcinoma radically is at the first surgical excision.

3. Laryngeal carcinoma arising on the aryepiglottic fold or pyriform sinus with secondary arytenoid or cordal involvement, or ventricular or false cord carcinoma extending into the pyriform sinus, or subglottic carcinoma with clinically positive nodes are ideally treated by this method.

4. Prophylactic neck dissection is recommended for extensive primary lesions in the above rich lymphatic areas.

5. Microscopically positive nodes were found in seven out of 18 prophylactic neck dissections (38.8 per cent). Six of the 15 occurred with subglottic and endolaryngeal carcinoma (40 percent). This suggests that the cure rate may be improved if prophylactic neck dissections were done routinely in extensive laryngeal carcinomas.

6. If a critical situation arises at the operation, the two-stage operation may be done with removal of the primary lesions first. A delayed neck dissection may be performed at a later date.

7. The one-stage procedure described allows direct inspection of the tumor before removal of the nodes is attempted.

8. The operative mortality rate in our series is slightly above that of laryngectomy alone.

9. Surgery is contraindicated in extensive anaplastic carcinoma with cervical metastases. Roentgen therapy is advocated for this type of lesion. Limited lesions showing anaplastic carcinoma are better treated with surgery followed by irradiation.

10. Radical surgery *may* be used where irradiation has failed in extensive lesions.

11. The cosmetic result, esophageal voice, and other functions appear as satisfactory as in a laryngectomy alone.

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SYMPOSIUM: CARCINOMA OF THE LARYNX.

I — CARCINOMA OF THE LARYNGOPHARYNX.*†

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There was a time, well within the memory of most of us, when even the mention of carcinoma of the laryngopharynx produced a mental reaction that is experienced only when one is confronted with a hopeless situation. At present there are grounds for some optimism. This optimism is based on available statistics that show not only an increasing salvage rate but also an increasing per cent of five-and 10-year arrested cases. These better percentages are the direct result of improved surgical technique, a better understanding of the principles of radiation therapy and its limitations and, of prime importance, the increasing numbers of early diagnoses.

The increasing number of early diagnoses is the direct result of a sustained, widespread program directed at the lay public as well as at all the practitioners of medicine, and the general practitioners in particular. All are cautioned to be on the alert for the early signs and symptoms of cancer. It is true that such a program produces an unwanted amount of fear and hysteria. It is also true that this is a low price to pay for the increased numbers of early diagnoses.

The history of carcinoma of the laryngopharynx lends itself for division into three periods. The first period is arbitrarily set in the second half of the nineteenth century. Prior to the daring surgery of Czerny,[1] Kocher,[2] Mikulicz,[3] von Hacker[4]

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and others, there were no even semisuccessful measures that were satisfactory for controlling or eliminating malignant neoplasms. The site of the lesion made it inaccessible for topical medication. The anatomy of the area and the proximity of vital structures prohibited the extensve use of escharotics and the actual cautery. Even after these earlier workers demonstrated that some of the patients could and did survive the trauma of extensive surgery, the procedure did not meet with widespread acclaim. The high mortality rate due to either infection or subsequent recurrence discouraged all but the most persistent surgeons. This was neither acceptable to the average practitioner nor to most patients, who, although knowingly doomed, refused to submit to major surgery when it offered such a small hope for survival and less for cure. Add to this their inadequate means for making an early diagnosis and it is evident why all but a few patients had extensive lesions and metastasis when they first presented themselves for consideration. Under these conditions few surgeons were qualified to perform the required extensive surgery and fewer were willing to risk their position and reputation by operating upon these known unfavorable cases.

The second period was initiated in the early 1920's and reached its peak some 15 years later. The results obtained by treating cancer with fractional doses of radiation were striking. The dissemination of this knowledge to both the lay and professional public made the name of Coutard a familiar one. For a time, all but a few who persisted in directing their efforts toward refinements in surgical technique dropped their interest in surgery and directed their efforts and their patients to radiation therapy. The whole idea of eradicating the cancer by a relatively unknown, almost mystical means, where in most instances there was no direct contact between the patient and source of the rays was and still is intriguing. The advantage of high voltage over low voltage X-ray soon led to the production of super voltage sources and from there to multiples of super voltage. It so happened that, being geographically placed as I am, and the fact that the "big" (60-inch) cyclotron of the late 1930's would permit directing a

beam of neutrons to only the upper portion of the patient, I had an opportunity to participate in the program of treating human malignancies with neutrons. The additional factor that oral and laryngeal lesions are visible, permit detailed observation and are easily accessible for biopsies, made this type of patient an ideal one for study. Unfortunately, the greater demands imposed upon the cyclotron and its personnel by unsettled world conditions necessitated a premature conclusion of this type of therapy and the cancellation of essential *in vivo* and *in vitro* experimental work. For reasons well beyond my control, this work was not resumed following cessation of the actual war. If this sounds a bit wistful it is because I cannot erase from my mind certain responses and reactions that took place during that relatively short period of employing neutron therapy. It is hoped that the future will offer an opportunity to collaborate in a renewed program or that others will determine whether or not the neutron beam has more to offer than has been produced by X-ray, radium or its substitutes.

The third and present period dates back to the early 1940's. It shows a definite reversion to extensive and extended surgery as the treatment of choice. Radiation therapy did have a fair and intelligently directed opportunity to show what it had to offer. It has proved to be a valuable instrument; it also has known limitations. Certain of these limitations have been and can be controlled and handled better by direct surgical approach. An outstanding example is the involved lymph nodes of the deep cervical area. It is of little value to control or eradicate a primary lesion if the metastasis in the adjacent or distant lymph nodes do not respond in a similar manner.

During the period that radiation therapy was enjoying popular acclaim, surgery was far from dormant. Surgical techniques were improved. Better organization and teamwork reduced both the time factor and the amount of tissue trauma. Advances in anesthesiology produced better types of anesthesia with fewer operative and postoperative complications. A better understanding of normal and abnormal human physiology indicated the necessity for attention to maintaining a normal fluid and electrolyte balance, as well as a sufficient

caloric intake. The more common use of whole blood and its fractions and substitutes showed that by these means it was possible to obtain the high level of metabolic economy that is desirable and has not been obtained in any other way. The acceptance of these facts and a more general realization that the patient is a biologic unit has forced the surgeon to maintain not only a high degree of technical skill, but also has imposed the additional duty of keeping up with the advances of modern physiology and medicine. The benefits resulting from the applicaton of such knowledge for adequate and intelligent preoperative and postoperative care are proven.

The advances in surgical technique and available means to avoid depletion of the patient's reserves would, of themselves, produce a marked drop in mortality per cents. It so happened that during the same period radiation therapy was the accepted method of treatment, ways and means of controlling or eliminating existing and secondary infections were made available. First, the chemotherapeutic agents, usually grouped under the term "sulfa," and then the antibiotic agents. The large number of these agents and the wide bacterial spectrum they cover, either individually or in combinations, where they may act as individual agents or synergists, is such that there are few infections that cannot be controlled or eliminated. With these thoughts in mind — improved surgical technique, a proper evaluation of the importance of the lymph nodes and lymphatic pathways of the head and neck, with means for their removal, a better knowledge of normal physiology, increased attention to the preoperative and postoperative care of the patient, and ways and means for controlling, combatting or eliminating infection — it is easy to account for the decrease in mortality rate from more than 50 per cent to less than 2 per cent, and the corresponding increase in survival rate for the accepted five-year period. Add to these general statements the ever increasing bulk of statistics used to prove these statements, and it is evident that extended and extensive surgery has much to offer. The word "radical" was purposely avoided. Too often the limited, narrow field, so-called conservative procedures have proven to be inadequate. Under

these conditions the "conservative" measures are truly radical when compared with the more favorable results obtained by employing extensive, so-termed "radical surgery."

It is fitting at this time, while thinking of statistics, to draw attention to those presented by one of our co-workers whose integrity is beyond question and whom I feel should be singled for special attention. He initially equipped himself to pursue a somewhat distant specialty. Soon after he had completed this training, he became interested in otolaryngology. His training in soft tissue surgery, plus a period of training with Dr. W. Trotter in England, gave him the necessary background experience and confidence to join and remain with the select few who carried on the work outlined by the pioneers in widefield and extensive surgery for the control and eradication of cancer of the laryngopharynx. A recent publication[5] presents a succinct summary of the laryngeal surgery this one individual has done. Two tables show the results of slightly more than 25 years of his work. The figures are impressive and warrant detailed study by all who are interested in laryngology. The total number of 344 cases with an operative mortality of 1.7 per cent and a high percentage of five-year cures is more than impressive. Few of the centers and groups have produced larger numbers or better results than are offered by this one individual. Many of the younger, and some not-so-young, laryngologists are indebted to him for the time and effort he expended in helping them obtain proficiency in this work. I feel that the record of Henry Boylan Orton warrants attention by all and commendation by those qualified to offer it.

It would leave an unfair and biased impression if I failed to mention the rôle radiation therapy plays in this third and present period. It is an important one, both in arrest, palliation and in combination with surgery. No single form of treatment has as yet presented a solution for the varied problems. The interests of the patient are served best by those who have spent time and effort to learn the fundamentals of all types of treatment. When this knowledge has been obtained, one is in a position to individualize the selection of

treatment to that best suited for the particular patient under question. Generalities have no place in the treatment of cancer; it is insidious and relentless. Until such time as the etiology of cancer is available — until we understand why a cell or group of cells which have heretofore led a well regulated, communal existence, should suddenly change to a completely nonconformist one, there can be no single specific form of treatment. Our present forms of treatment are based upon one or two principles: mechanical removal of the cancer, with sufficient normal tissue to make certain that all cancer cells have been removed, or, kill it *in situ* and simultaneously destroy a complement of normal tissue cells. All methods entail the sacrifice of varying amounts of normal tissue. In this regard, adequate surgery is more extravagant than properly administered radiation therapy. The surgical removal of the minimal amount of normal tissue often entails the extirpation of important structures or even entire organs. This results in varying degrees of disability and discomfort in accord with the tissues removed. The fact that most laryngectomized patients can learn to speak with an esophageal voice, and a goodly number do accomplish this feat, does not constitute complete rehabilitation; nor does the probability of attaining an esophageal voice detract from the value of a normally functioning, though possibly somewhat dry and telangiectatic larynx that may follow radiation therapy. Similarly, the complete stenosis that may follow infection of a radiated larynx and which demands a permanent tracheotomy has offered the patient none of the benefits of a laryngectomy. Such a larynx is a distinct hazard and should be removed. These known results are presented on a comparative basis to remind us that all our present means of treatment are based upon removal or destruction of tissue and none can offer selective action of sufficient specificity to remove only the malignant cells. Our backlog of experience and available statistics is sufficient to insist upon individualization in the selection of treatment that is best fitted for each particular case.

It is time to present a plea for exerting more effort toward diagnosing cancer in its earlier phase. All of you are con-

fronted with the problem of the patient with carcinoma of the upper respiratory tract, and all of you are actively responsible for the future of these patients. You are the one who will influence the patient to make decisions as to selection of type of treatment. You all know that the best survival rates are obtained in the group of early diagnosed cases and that these better rates are obtained with a minimum loss of tissue and function. It is your duty to devote time and effort in instructing all who will or must listen, to recognize the early signs and symptoms of malignancy. It is likewise important that you, yourself, exert maximum care in the routine examination of your patients — especially those who have been under your care for a long period of time and whom you have come to know as friends as well as patients. At some time one of their numerous complaints, too often taken lightly and for granted, may be based upon fact rather than fancy.

In closing, I suggest that we all increase our efforts to obtain a constantly increasing number of early diagnoses of malignancy and that we individualize the selection of the method of treatment rather than follow any fixed routine. If we are to derive real satisfaction from our work in this field let it be due to diminishing percentages of error and failures, rather than an increased total number of successes.

CONCLUSIONS.

1. That until such time as the etiology of cancer has been established, there is little hope of finding a single, specific form of treatment.
2. Our present methods of treatment entail the removal or destruction of varying amounts of normal tissue in order to eliminate or arrest malignancy.
3. The various accepted methods of therapy differ in mode of action and, therefore, should be selected to fit the condition rather than to trying to make the patient fit the type of therapy.
4. The earlier the malignancy is diagnosed, the less expensive its eradication. This is true whether expressed in units of time, tissue, function or dollars.

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SYMPOSIUM:

CARCINOMA OF THE LARYNX.

II — CERVICAL METASTASIS.

SURGICAL TREATMENT.*

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Introduction.

The present trend of treatment of advanced extrinsic squamous cell carcinoma of the larynx is toward radical surgery. In recent years not only the larynx with its primary disease but also the cervical metastases as well have been excised in continunity in a one-stage operation, thus fulfilling the requirements of cancer surgery; namely, removal of the primary growth and metastases *en bloc.* As early as 1906, Crile[1] pointed out that the lymphatic system of the neck is a unique barrier in limiting the spread of cancer from the head and neck, and further describes surgical techniques for block dissection of the lymph bearing channels and nodes.

During recent years otorhinolaryngologists have accepted this form of therapy and are applying these surgical principles in the treatment of laryngeal cancer so that a patient with this disease has more chance of survival than ever before.

The purpose of this discussion is to review a series of patients with cancer of the larynx who have been treated surgically. Since this study covers only a five-year period, it appears more logical to study failure cases rather than successful cases in order to help answer the problem of what type of surgery should be employed for any given case. Experience has taught that this type of surgery cannot be stand-

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ardized, but that it must be flexible, adaptable and individualized. This discussion, then, must be considered a preliminary report and only after a longer period of time can successful cases be evaluated.

Analyses of Cases.

During the past five years 75 cases with neoplasms of the larynx and hypopharynx have been observed. Seventy-four of these cases were diagnosed microscopically as having squamous cell carcinoma, while the remaining one case was diagnosed microscopically as having myxosarcoma of the larynx. For convenience, cases will be considered in the following categories:

1. Advanced Cancer.

Seventeen of the 74 cases presenting squamous cell carcinoma of the larynx or hypopharynx were considered too far advanced for any form of treatment on first examination. This again emphasizes that many cases of carcinoma of the larynx and hypopharynx are still not being diagnosed early enough for therapy. Several of these patients had inoperable primary lesions, several had "frozen necks," some had external fistulae, while still others had cervical metastases that were considered inoperable. The only surgical procedures carried out in this group were laryngoscopy, biopsy and tracheotomy, when indicated. As a whole this group of patients did not show generalized metastases. The disease was localized to the structures of the neck and usually remained so until death or just prior to death. Some of these patients received X-ray therapy as a palliative measure.

2. X-ray Therapy.

X-ray therapy was the recommended treatment in seven patients for the following reasons:

1. Generalized systemic disease contraindicated surgery.

2. Surgery was refused by the patient.

3. In several patients with squamous cell carcinomas of the intrinsic larynx, this therapy was the treatment of choice.

Two of the patients with small intrinsic carcinomas of the larynx that were treated by X-ray therapy subsequently required laryngectomy and will be considered under that category.

3. Laryngofissure.

The criteria established for laryngofissure have been rigid and only small squamous cell carcinomas occurring in the middle one-third of one vocal cord have been treated in this manner. Eight patients underwent this operation. Cervical metastases in this group of patients are unlikely and to date none of these patients has shown them. One patient in this group died of carcinoma of the lung following laryngofissure. The other seven are living and well.

4. Widefield Laryngectomy.

Thirty patients with extrinsic squamous cell carcinoma of the larynx were treated by widefield laryngectomy. Two patients in this group subsequently had bloc dissection of the neck and will be considered later. This leaves 28 patients to be considered here. On admission none of these patients had demonstrable cervical metastases. Seven patients in this group had had previous X-ray therapy varying from two months to seven years prior to the date of laryngectomy. Laryngectomy has failed to arrest the cancer in seven of these patients. Six of the patients have already died from cancer, while one patient is living with cancer and undoubtedly will soon succumb. Primary locations of the neoplasms in these seven failure cases were as follows: three lesions were subglottic; two were of the epiglottis, and two originated over the arytenoid area. In spite of adequate follow-up examinations, a later surgical excision of the metastases was not possible for the following reasons:

1. Metastasis of the cancer to the superior and inferior deep jugular lymph nodes was extremely rapid and the nodes were matted and bound down to adjacent structures.

2. The spread of the cancer by direct continuity to the thyroid gland and the lymph nodes between the trachea and the esophagus was extensive.

3. The direct spread of the cancer to adjacent soft tissues caused "frozen neck.'

It is impossible to state whether any of these patients could have been treated successfully had prophylactic bloc dissection of the neck been performed in conjunction with the primary widefield laryngectomy.

5. Widefield Laryngectomy or Widefield Laryngopharyngectomy Combined with Bloc Dissection.

The patients of primary concern to us are those who had cervical lymph node metastases on admission, those who developed lymph node metastases during observation and those who would possibly develop them. Fourteen patients can be classified in these groups. Six of these patients will be considered later, since four of them had bilateral bloc dissections of the neck plus laryngectomy, while the other two had bloc dissections of the neck following widefield laryngectomy. This leaves eight patients to be considered here. On admission six of these patients with extrinsic squamous cell carcinoma of the larynx and hypopharynx had palpable cervical lymph node metastases on the same side as the primary lesion. In five of these cases cancer bearing lymph nodes were found microscopically in the surgical specimens, while in the sixth case, although there were cervical lymph nodes palpable, microscopical examination of 29 nodes in the surgical specimen showed no evidence of cancer, denoting that clinical palpation cannot be relied upon exclusively to determine the presence of cancer. One patient with subglottic primary carcinoma and one patient in whom the cancer involved the arytenoid area had prophylactic bloc dissections of the neck in conjunction with the widefield laryngectomy. Although lymph nodes were found in these latter two surgical specimens, there was no evidence of cancer within the lymph nodes examined microscopically. The primary site of the neoplasm in two other patients was the pyriform sinus. The remaining four patients of this group had primary lesions involving the true and false cords, the aryepiglottic fold with infiltration of the neoplasm into the posterior inferior surface of the epiglottis. There

has been one death in this group of eight patients and this patient died six months after the original surgery from unarrested cancer. This patient had had a complete course of X-ray therapy seven years previously.

6. Widefield Laryngectomy and Bilateral Bloc Dissection.

These operations were carried out in two stages. Widefield laryngectomy and bloc dissection of the neck were done in one stage, while the contralateral bloc dissection was done from five weeks to two years later. There were four patients in this group. On admission three of the patients had palpable lymph nodes on the same side of the neck as the primary laryngeal lesion, while the other patient had bilateral palpable lymph nodes. In seven of the eight surgical specimens in these four patients, cancer was found in the lymph nodes microscopically. One patient may be considered to have had a prophylactic bloc dissection of the neck following the appearance of a new neoplasm of the hypopharynx two years after the original operation, which was performed for an extrinsic submucosal squamous cell carcinoma of the false vocal cord with cervical lymph node metastases. This patient is living and well three and one-half years following the original operation. One patient is dead from cancer. The other two patients are living with cancer and no doubt will soon succumb. The primary lesion of the larynx in these latter three patients involved the true and false cords, aryepiglottic fold with infiltration into the posterior inferior surface of the base of the epiglottis.

7. Bloc Dissection Following Widefield Laryngectomy.

There were two patients who had widefield laryngectomy and who later developed cervical metastases which were considered operable. The interval between laryngectomy and bloc dissection varied from four to seven months in these two patients. Here again the primary extrinsic lesions in both of these cases were found to involve the true and false cords, the aryepiglottic fold with infiltration into the posterior inferior surface of the base of the epiglottis. The primary lesions were apparently controlled by the widefield laryngectomy.

Microscopically cancer was found in the lymph nodes in the surgical specimens in both of these patients. One patient is dead, while the other one is living with cancer and has completed a full tumor dose of X-ray therapy to a limited area of the neck.

8. Lateral Pharyngectomy.

Lateral pharyngectomy was performed on one patient who presented a myxosarcoma of the left lateral wing of the thyroid cartilage. A partial laryngectomy as well as a partial pharyngectomy was done. The patient died one year later of generalized metastases from the myxosarcoma.

In considering the 51 patients who had some form of surgical treatment for cancer of the larynx or hypopharynx, there have been 15 failures and they may be listed by groups as follows: In the laryngofissure group there has been one death due to bronchogenic carcinoma unrelated to the laryngeal cancer. In the group of laryngectomized patients there have been seven failures from unarrested cancer. In the group where widefield laryngectomy and bloc dissection have been done as a primary procedure, there has been one death in eight cases. In the widefield laryngectomy and bilateral bloc dissection group, there have been or soon will be three deaths in four patients. In the two patients who had widefield laryngectomy and later had bloc dissection, there have been no successes. One patient who underwent lateral pharyngectomy for myxosarcoma of the thyroid cartilage died. Outside of the laryngofissure group, the lowest morbidity and mortality rates have been in the group of patients wherein widefield laryngectomy and bloc dissection were performed in a one-stage operation. None of the deaths in any of the groups has been attributable to surgery.

Mode of Spread of Laryngeal Cancer.

In all the above groups there are 13 patients with primary extrinsic squamous cell carcinoma of the larynx where surgical treatment has failed and the patients have succumbed

from the disease or soon will. A study of these cases shows lesions in the following primary locations and the areas to which metastases have occurred.

1. Epiglottis.

Primary squamous cell carcinoma of the epiglottis tends to spread by way of the lymphatic channels to the deep superior jugular lymph nodes and the submaxillary group of nodes. There is also a tendency of these lesions to erode the epiglottis and to spread by direct continuity into the base of the tongue.

2. Subglottic.

Subglottic squamous cell carcinoma tends to metastasize early to the inferior and middle deep jugular nodes. The pretracheal and esophageal lymph nodes may be involved. Direct extension to the esophagus and trachea can occur. Microscopical sections of the thyroid gland from autopsy material in two cases showed invasion by cancer cells.

3. Arytenoid Area.

Primary extrinsic squamous cell carcinoma of the arytenoid area tends to metastasize early to the inferior deep jugular nodes, the pretracheal and esophageal lymph nodes. Here again direct extension may take place to the esophagus, trachea, the thyroid gland and adjacent tissues.

4. False Cord.

Extrinsic squamous cell carcinoma of the false cord may spread by direct continuity to the aryepiglottic fold and the inferior posterior surface of the epiglottis. From these areas the lesion may metastasize early to the cricothyroid lymph nodes, the thyroid nodes and the superior and middle deep cervical jugular nodes. In some cases it is difficult to determine the exact anatomical site wherein the primary lesion originated. In this latter group of cases this was particularly true since many of the cases were seen in an advanced stage of the disease. Undoubtedly the true vocal cord was the primary

anatomical site of some of these lesions, although it was difficult to determine this even after examining the larynx following its removal.

The most important routes of spread of cancer of the larynx as noted above are by way of the lymphatic system and by direct extension; however, another infrequent mode of metastases is by the hemotogenous route. In one case which was considered hopeless upon admission, the anterior jugular veins of the neck were completely thrombosed by squamous cell carcinoma, as proven microscopically. This patient died of generalized metastases. Likewise, in the case of myxosarcoma of the thyroid cartilage, metastases were hematogenous in nature.

Prophylactic Bloc Dissection.

It is agreed among most surgeons that bloc dissection and widefield laryngectomy is the operation of choice in patients presenting extrinsic laryngeal cancer with well defined cervical metastases; however, to date there is no uniformity of opinion as to which patients should be subjected to prophylactic bloc dissection in conjunction with widefield laryngectomy in the absence of discernible lymph nodes. Recent studies by Ogura[2] show that in spite of the lack of clinical palpable cervical nodes in certain patients upon whom widefield laryngectomy and prophylactic bloc dissection of the neck have been performed, approximately 38 per cent of the surgical specimens have shown microscopical metastatic carcinoma. Accepted survival rates for patients undergoing laryngectomy are approximately 60 to 70 per cent. It is the hope of all surgeons to reduce these 30 to 40 per cent morbidity and mortality rates and yet at the same time not perform needless surgery. It would be years before two parallel series of similar cases could be studied adequately, wherein one series of cases would be treated solely by widefield laryngectomy and the other series would be treated by widefield laryngectomy and prophylactic bloc dissection; therefore, the surgeon must rely on certain clinical signs and anatomical locations of primary extrinsic laryngeal cancer for guidance as to the type

of surgery to be employed in individual cases. Clinical signs that may help to determine the feasibility of prophylactic bloc dissections are:

1. Size of the primary lesion.
2. Degree of fixation.
3. Ulceration.
4. Necrosis of cartilage.
5. Edema.
6. Induration.

Extrinsic lesions in the following anatomical locations should be considered for this type of surgery:

1. Subglottic Lesions.

Included in this group would be either primary subglottic lesions or those extending subglottically by direct extension.

2. Epiglottis.

Unilateral lesions of the epiglottis occurring below the glossoepiglottic ligaments without direct extension into the base of the tongue.

3. Arytenoid Area.

Cases of primary cancer of the arytenoid area, although rare, must be considered as candidates for prophylactic bloc dissection.

4. False Cord and Aryepiglottic Fold.

Such lesions may occur primarily on the true vocal cord and by direct extension involve the false cord, aryepiglottic fold and posterior inferior surface of the epiglottis. These cases are frequently seen in this advanced stage of the disease and hence should be considered as potential candidates for prophylactic bloc dissection.

5. Pyriform Sinus.

Although not a subject for this discussion, pyriform sinus lesions should be attacked surgically only if prophylactic bloc dissection is carried out in conjunction with the pharyngectomy or laryngopharyngectomy.

In the present series of cases three patients had prophylactic bloc dissections of the neck in conjunction with the widefield laryngectomy. In none of the surgical specimens were gross or microscopical metastases found. The validity of these findings is probably not significant since our technique for examining surgical specimens for microscopical metastases is not refined at the present time.

Bilateral Bloc Dissection of the Neck.

When bilateral bloc dissections of the neck and laryngectomy are required to treat cancer of the larynx, one is dealing with a far advanced form of the disease and the prognosis for arresting the cancer is extremely poor. In this series of cases three of the four who underwent this surgery succumbed or soon will from the disease. There were no surgical complications in this group of four patients who had bilateral bloc dissection and widefield laryngectomy. When the contralateral jugular vein was ligated at a later date, there was some facial edema and slight cyanosis which subsided in approximately 10 days following surgery. The time interval between the two operations in this group of patients varied from five weeks to two years. In all four patients collateral circulation apparently established itself in a matter of a few days. Bilateral bloc dissection of the neck is a procedure to be reserved for a certain few patients wherein the salvage rate is low by any known form of treatment.

Surgery.

A majority of the patients that underwent widefield laryngectomy were operated upon through a low collar incision. The incision may be likened to a thyroidectomy incision except that it is placed higher in the neck just below the cricoid cartilage. It has been used successfully even in those patients

who have undergone previous irradiation. If a combined bloc dissection and laryngectomy are to be carried out in one stage, one arm of the incision is carried up along the posterior border of the sternocleidomastoid muscle to the region of the mastoid process. The platysma muscle or muscles are reflected with the skin flap. By the use of such incisions fistula formation is lessened, and should it occur the saliva and contents of the pharynx will drain toward the supraclavicular fossae rather than toward the stoma area. Further, the tissue remaining for closure of the hypopharynx may be inadequate, and this large buttress of skin and platysma muscle acts as a reinforcing structure. A solid flap over this area tends to aid in primary healing.

The surgical procedures have been so extensive in some patients that there has been little pharyngeal or esophageal mucosa with which to close the wound; however, if the mucosa of the esophagus and pharynx is sutured over a small feeding tube, healing will occur and function of the esophagus will be restored. It has been a routine procedure in this series of cases, wherein bloc dissection and laryngectomy have been carried out in one stage, that the lobe of the thyroid gland on the same side as the lesion be included in the surgical specimen. There have been no complications from this procedure in spite of the fact that the parathyroid glands have not been identified in all cases. The strap muscles are included in the surgical specimen. The removal of the hyoid bone insures complete surgical removal of the pre-epiglottic space.

The criteria used to determine the feasibility and operability of a particular case in the surgical treatment of cervical metastases and primary extrinsic laryngeal carcinoma may be summarized as follows:

1. The patient must be free from generalized metastases as demonstrated by X-ray of the chest, long bones and spine.

2. The patient must be a reasonably good surgical risk and have no generalized systemic disease that would contraindicate this type of surgery. Age alone is no contraindication.

3. There must be reasonable assurance of excising the primary growth widely and adequately through normal tissue. In some cases where the primary growth has been adequately controlled previously, bloc dissection may be carried out providing the lymph node metastases are considered operable.

4. The lymph node metastases must be in such an anatomical location and of such a nature that they can be approached and successfully removed surgically through normal tissue.

5. The great arteries of the neck must be free from tumor cell invasion; however, at surgery it has been our policy to remove all gross cancer except that which infiltrates the musculature of the great arteries so that the vessels themselves will not have to be ligated and removed. When healing occurs, limited areas where known cancer cells remain are treated with tumor doses of X-ray therapy.

Postoperative Care.

Unusually large doses of antibiotics are given to all patients who have undergone this radical form of surgery. Whole blood transfusions have been used liberally. Esophageal dilatations have successfully re-established the lumen of the esophagus in several cases. The Hurst mercury-filled esophageal dilators have been found to be useful instruments for these dilatations. Esophageal speech has been developed successfully and satisfactorily even in patients with bilateral bloc dissection of the neck and widefield laryngectomy.

SUMMARY.

Seventy-five cases with neoplasm of the larynx have been presented. Seventy-four of these cases were diagnosed microscopically as squamous cell carcinoma, while the remaining case was diagnosed microscopically as myxosarcoma. Seventeen of these cases were considered inoperable and beyond any form of treatment except palliation when first examined. Seven patients were recommended for X-ray therapy as the treatment of choice. Fifty-one patients were treated surgically. Eight patients underwent laryngofissure. Twenty-eight

patients underwent laryngectomy, while 14 patients had some form of laryngectomy plus bloc dissection of the neck, either unilateral or bilateral. One patient underwent lateral pharyngectomy. The overall morbidity and mortality in this group of patients has been 29 per cent.

CONCLUSIONS.

1. One-stage widefield laryngectomy and bloc dissection of the neck is the operation of choice in patients with advanced extrinsic squamous cell carcinoma of the larynx with palpable cervical metastases.

2. Widefield laryngectomy and prophylactic bloc dissection of the neck should be considered in patients with primary extrinsic cancer of the epiglottis occurring below the glossoepiglottic ligaments, in those patients with cancer of the subglottic area, in those patients with cancer of the arytenoid area and in those patients where the lesions involve the true and false cords, the aryepiglottic fold with infiltration into the posterior inferior surface of the base of the epiglottis.

3. Laryngectomy and bilateral bloc dissection of the neck are surgical procedures that are feasible in certain well selected cases.

4. The surgical excision of cervical metastases following widefield laryngectomy has been disappointing in our experience. In fact, in none of the cases that developed recurrent carcinoma following widefield laryngectomy has the disease been arrested.

5. All pyriform sinus lesions should have a prophylactic bloc dissection of the neck in conjunction with widefield laryngectomy or widefield laryngopharyngectomy.

6. Extensive surgical procedures upon the larynx and the lymph bearing tissues in the neck have been made possible through improved techniques in anesthesia and surgery, the use of whole blood transfusions and the liberal use of antibiotics pre- and postoperatively.

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SYMPOSIUM:

CARCINOMA OF THE LARYNX.

III — X-RAY THERAPY.*

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The selection of treatment for cancer of the larynx depends upon many factors, such as the size and location of the tumor, the mobility of the cords, the age, general health and mental attitude of the patient, and whether or not the nodes of the neck are clinically involved. In early cord cancer, X-ray therapy apparently gives as good results as surgery, in terms of survival or cure, and gives better results in terms of function. It is more tedious to apply but less mutilating in its end-results. On the other hand, in advanced cord cancer, with cartilage invasion or marked secondary infection, and in extrinsic laryngeal cancer, it is believed by many that radical surgery gives superior chances of survival to those obtainable with X-ray.

The following paper is a report based on our experience with over 130 cases of cancer of the larynx treated by Roentgen therapy during the last 18 years. Sixty-nine of these cases were treated prior to 1946 and are, therefore, suitable for five-year analysis. About two-thirds of them were seen on a county hospital service and, therefore, contain a fairly high proportion of unfavorable or advanced material.

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MATERIAL.

All of the cases were seen by the author or his associates (Dr. H. A. Hill, Dr. M. E. Mottram and Dr. M. A. Sisson) and had been referred by laryngologists or other surgeons, following histological verification. The 69 cases suitable for five-year study were all squamous cell carcinomas. In two additional cases, the existence of carcinoma at the time of X-ray therapy was questioned on subsequent review: these have been *excluded* from this report. One was a case with a very small biopsy, originally interpreted by the pathologist as carcinoma but subsequently reported as probable leucoplakia. The other was a patient with recurrent carcinoma following laryngofissure; after biopsy verification of the recurrence, the patient was started on X-ray therapy but discharged himself from treatment prior to its completion. He received a tumor dose of only 2,500 r. in 10 days and was alive and well five years later. It is possible that the second biopsy removed all of the recurrence. He is excluded.

Radical radiotherapy is a major undertaking, and we believe that every therapist should seek thorough clinical and microscopic validation of a diagnosis of cancer before undertaking curative treatment.

An attempt was made to classify all cases according to the location and estimated extent of disease, using the classification shown in Table I. Radiographic examination (including tomograms) of the larynx and pharynx was of some value in this staging and provided a permanent record of the status of adjoining structures. Needless to say, the precise site of origin of some advanced lesions could not be established.

The classification employed is not regarded as an ideal one; however, it seemed to be the most practical clinical one at the time of our first report on this work, in 1934, and for pur-

TABLE I. CLASSIFICATION OF CASES.
CANCER LARYNX—CLINICAL CLASSIFICATION AND STAGING.

Intrinsic.	Tumor arising from true cord or laryngeal ventricle.
Stage I.	Single cord, without fixation.
II.	Both cords, or one cord with partial fixation.
III.	One or both cords, with cart. invasion or met.
Extrinsic.	Tumor arising from upper surface of false cord, epiglottis, ary-epiglottic fold, arytenoid, laryngeal surface of pyriform sinus or postcricoid area.
Stage I.	Less than 1 cm. in diameter.
II.	From 1 to 3 cm., but without cart. invasion.
III.	Over 3 cm., or with cart. inv., or metastases.

poses of consistency we have adhered to it since that time; further, it is comparable to many in use by other radiotherapists.

Clinical classification is useful for guidance in the selection of therapy and also for purposes of prognosis. Most small tumors, especially true cord lesions, offer a good prognosis for cure, surgical or radiotherapeutic. Many more extensive tumors also can be controlled by irradiation; but the cure rate falls rapidly, and radical surgery is probably a superior method of treatment in certain of these cases. The significant factor omitted in any classification is a reliable clue to the "biological type" of the cancer in a given case. This, of course, is undeterminable in the present stage of our knowledge of tumors. It is not well correlated with microscopic morphology or "grading"; in some cases, it seems to bear some relation to the clinical rate of the growth of the lesion.

In most of our cases, the biopsy specimen was graded by the pathologist into one of three general groups: well-differentiated, poorly-differentiated and unspecified type epithelioma. Jackson and Blady, Mustakallio, Lenz and others found some correlation of prognosis and radiocurability with grading, but Harris, Lederman, Cutler and others regarded grading as unreliable for such purposes. Our small experience coincides with this latter opinion.

The apparent anatomic location of the primary tumor in the 69 cases treated was as follows:

Intrinsic.	Vocal cord, ant. two-thirds	3 cases	
	Vocal cord, post. one-third	1 case	
	Vocal cord, entire	13 cases	
	Both cords	11 cases	
	Cord, with subglottic extension	1 case	
	Unclassified	2 cases	Total 31
Extrinsic.	Epiglottis	12 cases	
	Aryepiglottic fold	1 case	
	Arytenoid	6 cases	
	False cord	3 cases	
	Pyriform sinus	7 cases	
	Postcricoid area	1 case	
	Unclassified (extensive)	8 cases	Total 38

The clinical stage of the different lesions varied widely, a majority being in Stage III. The following summarizes the stages in the 62 cases which completed treatment:

Intrinsic.	Stage	I	3 cases	
		II	8 cases	
		III	18 cases	Total 29
Extrinsic.	Stage	I	1 case	
		II	5 cases	
		III	27 cases	Total 33

TREATMENT.

The irradiation technique employed in our cases is based on the earlier principles of Coutard, whose clinic at the Institut du Radium I was privileged to visit in 1932 (prior to the start of this work). Each patient is examined by mirror before, during and after completion of therapy. At the time of the first treatment, the estimated center of the tumor is marked on the patient's skin (on each side of the neck) under fluoroscopic guidance, with the patient lying on his side in the precise position he will occupy on the treatment table. When necessary, spot films are made with a small lead marked over

the central point. Precision in aiming the subsequent beam of Roentgen rays is essential, and each case is set up and observed by the radiotherapist at every treatment visit. Whenever possible, the entire course is given under the personal direction and supervision of the therapist who initiated the course.

The usual technical factors of 200 to 250 KV, 15 to 25 MA, half-value layer of 1 to 2 mm. of copper, and distance of 50 to 70 cm. were used throughout this series. The major variables were field size and duration of treatment. Most cases were started with two directly opposing 10 or 8 cm. circular beams, and the beam size was gradually reduced during therapy when such was considered advisable — but rarely below 5 cm. diameter. In recent years, a beam of small size tended to remain unchanged throughout the course. A few of the very advanced or extensive lesions were treated through large, 10 x 14 cm., fields initially. In some of the first treated cases, an anterior field also was irradiated; this was subsequently dispensed with. No "scattering" material or bolus bags were used.

Except in the presence of a very narrow airway, the initial dose was usually 100 r, *air*, to one lateral field. This was increased to 150 r next day and 200 r on the third, in the absence of undesirable reaction (treating alternate sides daily). Treatment was continued at the rate of 200 r a day to one field, for another few days and, in some cases, increased to 250 or 300 r, depending upon the individual problem. The larger the field the smaller the daily dose tended to be.

Treatments were given daily, six days per week, until the planned dose had been administered or the planned mucosal reaction was produced in the larynx. In many cases the planned dose was 5,000 r, tumor, in four weeks. This required about 3,000 r, air, to each of the two lateral fields, in 28 treatment days. In a few cases treatment had to be suspended prior to completion, because of severe local or general reaction, or because of complications unrelated to therapy (debility, bronchopneumonia, etc.).

When epithelitis did not appear at the expected time, treatment was continued for a few additional doses, but rarely to exceed a total of 3,500 r, air, to each side of the neck, except under unusual circumstances.

The epithelitis present at or near the end of treatment usually took two to four weeks to subside and, in favorable cases, the tumor usually disappeared by the time the mucosal reaction was fully healed; however, in a fair number of cases, complete disappearance of the mass or swelling in the area of the primary tumor required as long as three months following the end of treatment. Some of these cases were a source of apprehension, since early surgical treatment might have been advisable in the presence of established residual tumor. In general, we do not believe that three months is too long a post-therapeutic observation period in cases showing recession.

The side effects and complications of treatment have been dealt with in other publications and do not need reiteration here.

RESULTS.

The immediate and late results of treatment of tumors arising in elderly persons are apt to be somewhat discordant. While a good proportion of cases may show initial arrest by radiotherapy (or surgery), many will die of intercurrent disease — with their tumor apparently controlled — prior to the time of the desired five- or 10-year follow-up period. Our group of cases behaved in similar fashion.

Of the 69 primary cases of cancer of the larynx submitted to radical radiotherapy, seven failed to complete treatment for a variety of reasons — terminal cases which developed bronchopneumonia, advanced cases with tracheoesophageal fistula, and cases in persons too old or feeble to tolerate daily visits to the therapy table. This leaves 62 cases who completed treatment. Sixty of these were traced: 23 died of cancer; eight of other causes, but the status of their laryngeal lesions was not certain; 16 died with their larynges clinically or microscopically healed; and 13 are living and well, five or more years (see Table II).

TABLE II. CANCER LARYNX — FIVE-YEAR RESULTS IN 69 PRIMARY CASES FOR PERIOD 1933-1946.

Number of cases treated	69
Treatment incomplete	7
Treatment complete	62
Died of cancer (failures)	23
Died of various causes (larynx apparently healed)	8
Died of other causes, without evidence of cancer (autopsy check in 6)	16
Lost to follow-up but well when last seen	2
Living and well five or more years	13

Of the 62 cases which completed treatment, the lesions were almost equally divided between intrinsic and extrinsic. The results by stage may be seen in Table III.

TABLE III. RESULTS OF X-RAY THERAPY IN 62 CASES.

	Intrinsic			Extrinsic		
	I	II	III	I	II	III
Total No.	3	8	18	1	5	27
Initial arrests	3	7	7	1	3	10
(%	100	87	39	100	60	37 %)
Well 5 or more years	2	2	4	1	2	2
D.O.C.* (& 2 lost)	1	5	3	0	1	8
Relative cure rate	2/2	2/3	4/15	1/1	2/4	2/19
(%	100	66	27	100	50	10 %)
Determinate results	8/20 or 40%			5/24 or 21%		
	13/44 or 30%					

*Dead of other causes; larynx clinically well, 16 cases.

If those dying of other causes (intercurrent disease), and those lost track of but clinically well when last seen are ex-

cluded — a total of 18 cases — there remain 44 determinate cases, with a relative cure rate of 30 per cent.

The relationship of stage to survival is evident from a review of the results in early and advanced cases. For the determinate group, this is shown in Table III. It is realized that the number of cases in any one group is too small to warrant figures in "percentages"; however, for purposes of comparing the results obtained in the different stages, percentages are convenient and, we believe, permissible.

The above paragraphs and tables emphasize *five-year arrests* or clinical cures. The immediate or initial arrest rate also invites consideration in a tumor involving persons as old as most patients with laryngeal cancer. It is realized that some of these initial arrests *are* temporary, and that the patient might have developed recurrences had he lived out the full five-year period or longer, but the figures are comparable with some appearing in the surgical literature and merit review. As in the case of late results, the lesions staged 1 and 2 give much better response than the advanced ones (see Table IV).

TABLE IV. CANCER OF LARYNX—INITIAL RESULTS OF RADIOTHERAPY.

	Arrest Rate in "Early" or "Moderate Extensive" Lesions.	
Extrinsic.	S. I and II	11 cases treated
	Arrested	10 (90%)
	Died intercurrent disease	6
	L. and well over 5 years	4
	Arrest Rate in "Late" or "Extensive" Lesions.	
Intrinsic.	S. III	18 cases treated
	Arrested	7 (39%)
Intrinsic.	S. III	27 cases treated
	Arrested	10 (37%)

The advanced nature of many of the cases referred to a radiotherapist, especially in the earlier years of radical laryngeal X-ray therapy, is illustrated by the proportion requiring

tracheotomy *prior* to therapy. Of the total group of 69 primary cases referred for treatment, *18 already had required tracheotomy — 26 per cent* — (and eight had cervical node metastases). It is probable that some of these would no longer be accepted for radical radiotherapy and would instead be recommended for radical surgery.

Four of the entire group required or were given tracheotomy during treatment and two following completion of therapy.

Two of the group developed chondronecrosis, one approximately three months following therapy, and one eight years after such.

Two developed recurrences, one at the end of three and one-half years and one at the end of seven and one-half years following therapy.

DISCUSSION.

Correlation of Dosage with Clinical Cure. In the 13 cases which were arrested for five or more years, the estimated midtumor dose ranged from 4,500 r in 30 days to 6,300 r in 52 days. In most cases the dose was approximately 5,300 r in 35 days (requiring, on the average, 3,200 r, air, to each of two opposing lateral neck fields). These doses are in the low range of those commonly accepted as curative for squamous cell cancer, but in our experience they represent about the maximum tolerated by the normal tissues adjacent to the tumor, using our type of treatment factors. Increasing the dose might increase the number of cures but would, we believe, unquestionably increase the incidence of chondronecrosis.

We recalculated the midtumor dose according to Strandquist's fractionation curve for a hypothetical standard 35 days in each case of the 13 arrested lesions and found that the range was from *4,400 to 6,500 r* (with an average of 5,334 r) in *35 days* (see Table V).

TABLE V. TUMOR DOSES IN CASES WELL FIVE OR MORE YEARS.

Case No.	Mid. T. Dose r/days		Corresponding T. Dose/ 35 days*	Aver. Diam. of X-ray Beam (cm.)
2	5550/40		5200	7
17	5500/25		6250	10
23	5200/43		5000	8
26	5400/38		5250	7.5
28	4400/?5		4400	7.5
40	5500/45		5100†	9
42	6300/52		5500	8.5
46	4500/30		4900	6
47	4900/30		5150	7.5
51	6100/31		6500	9
53	5800/35		5800	9
66	5400/46		4900	5
68	5500/37		5400	6.5
		Range	4400-6500	(5-10)
		Av.	5334	(7.6)

*Based on Strandquist's fractionation curve.
†This case also had additional treatment: see text.

The *rate* of administration is probably as important as the total dosage in the development of troublesome early edema or late chondronecrosis. Both complications can virtually be avoided by graduation of dosage in the initial stages and by avoidance of excessive dosage in the later.

Late chondronecrosis attributable to radiotherapy developed in one case in which reirradiation was used eight months after the initial course of treatment. This is the only case in the entire series in which a second course of treatment was given, and in this case it was given because of a misunderstanding. The patient was a man of 50 with a Stage III tumor, extrinsic (the left arytenoid, pyriform sinus and true cord were involved). After a moderate course in June, 1940, totalling 2,000 r, air, to each of two large fields his tumor disappeared, and treatment was discontinued. In February, 1941, he had evidence of recurrence and was re-treated to a similar dosage. His tumor again disappeared, and he survived well until June, 1948, when he developed chondronecrosis, with secondary bronchopneumonia, and died.

Early chondronecrosis developed in one case, after moderately intense treatment (3,600 r, air, to each of two fairly large fields in 40 days). The patient, a man of 49, had a Stage III extrinsic lesion (squamous cell carcinoma of the epiglottis with cartilage involvement). Three months after completing treatment he developed edema and chondritis, and succumbed.

We believe that moderation in therapy, as currently practiced, has eliminated the hazard of chondronecrosis of purely radiation origin. It may still be anticipated in the occasional case with masked chondral infection present prior to therapy. Prompt laryngectomy will probably salvage such cases. Vigorous treatment with modern antibiotics should also help.

Permanence of Results: When cure is achieved by Roentgen therapy, we believe that the results are just as permanent as those obtained by other methods. The following are the records of the 13 cases of five-year "cures" reported herewith:

Serial No.	Well for Years	Present Status*
2	8	Died, intercurrent disease.
17	5	Untraced after fifth year.
23	13	Died of coronary occlusion.
26	14	Living and well.
28	5	Died of coronary occlusion.
40	8	Died of bronchopneumonia (necr.)
42	9	Untraced after ninth year.
46	11	Living and well.
47	11	Living and well.
51	10	Living and well.
53	9	Living and well.
66	5	Living and well.
68	5	Living and well.

*Color photos of patients living and well for five to 14 years were shown at the American College of Surgeons meeting in San Francisco.

Treatment of Postirradiation Failures. It is believed by some surgeons and radiotherapists that early surgical removal is indicated in the presence of persistent or recurrent tumor following irradiation. In recent years it has been well estab-

lished that surgical dissection and subsequent wound healing is not interfered with by properly administered, *single* courses of radical Roentgen therapy. Our own experience with post-radiotherapeutic surgery is too small to warrant definite opinion.

Metastatic Nodes. When there is clinical evidence of involvement of one or two nodes immediately adjacent to the larynx, and these can be included in the beam used for treating the primary lesion, radiotherapy has been sometimes successful; however, when the nodes are numerous, or are situated in the deeper cervical tissues at some distance (*e.g.*, over 5 cm.) from the edge of the primary tumor, we have not obtained any cures. Frankly, we believe that palliation is all that can be offered most such cases; surgery even of the most radical type is rarely curative.

Arrest was obtained in three of the eight cases with nodes in this series, but unfortunately all three died of unrelated causes prior to the lapse of five years' time.

When nodes develop following control of the primary, three courses are open: *a.* when the node is solitary and at some *distance* it may be excised or verified by aspiration biopsy and local intense postoperative irradiation given; *b.* when the nodes are in the formerly treated area or are multiple, but apparently operable, neck dissection is warranted; *c.* when the nodes are multiple and fixed, only palliative irradiation is indicated.

Results in the Literature. The results of surgical treatment of suitably selected early cord cases are reported in the 70 to 85 per cent range and of selected total laryngectomy cases in the 50 to 60 degree range. It is not possible to compare with any accuracy these surgical figures and most radiological figures. The former deal almost essentially with *operable* cases; the latter with *operable, inoperable* and *recurrent* cases. The following are published relative five-year cures by Roentgen therapy, all types of cases considered:

Coutard (142)	1938	27 per cent
Schinz (39)	1939	25 per cent
Nielsen and Strandberg	1942	22 per cent
Mustakallio	1944	30 per cent
Lenz	1947	27 per cent
Cutler	1948	35 per cent
Blady *et al.* (69)	1948	51 per cent
Baclesse (260)	1948	20 per cent
Baclesse (59)	1948	34 per cent
Cutler (156)	1950	37 per cent
Harris *et al.*	1950	56 per cent

With the exception of the last figure, which pertains (in the authors' words) to material "more favorable than the average," and Blady's small series, it is seen that the range is from 22 to 37 per cent. Our own figure, as previously noted, is 30 per cent.

The results of Hayes Martin, about 10 per cent, and of Paterson's group at the Holt Radium Institute, about 14 per cent, pertain so largely to advanced disease that they require separate consideration. Harris *et al.* have already discussed Martin's material. The following is a summary of the most recently published Holt Radium Institute material: cases without nodes, intrinsic, 32 per cent five-year arrests, extrinsic, 13 per cent arrests; all cases (*i.e.*, both without and with nodes), intrinsic, 26 per cent, extrinsic, 6 per cent. Combined results, in 236 cases, 14 per cent crude five-year survival.

When cases from two representative clinics in this country are divided into intrinsic and extrinsic groups, the following relative cure rates are published:

Blady *et al.*	59 per cent and 25 per cent
Harris *et al.*	75 per cent and 40 per cent

Again, these figures require interpretation in the light of the relative proportion of early and late cases in each group. In addition to their being handled by very skilled radiotherapists,

it is apparent that both Harris' and Blady's series contain a higher proportion of early lesions than most reported groups. Our own results are of course inferior to either of these series (being, respectively, 40 per cent and 20 per cent); we believe it is fair to attribute part of this to the advanced stage of many of our cases.

Palliative Effects of Roentgen Therapy. In primary inoperable cases, and in many cases recurrent after operation, significant palliation may often be achieved by judicious treatment. Space does not permit consideration of this important phase of the problem at this time.

Use of Other Types of Radiotherapy. Many varieties of ionizing beam are at the disposal of the radiotherapist. Since about 1920, "supervoltage" beams in the form of the radium cannon (Berven), the radium collar (Murdoch) and the radium palisade (Finzi-Harmer) have been used. Since 1930, supervoltage X-ray beams from units operated at 1,000 and 2,000 KV have been tried. Since 1932, rotation therapy, contact therapy and other variations in the medium and low voltage Roentgen beam range have been employed. We have seen the results of treatment in some of the cases treated with most of the above technical variants; however, no data have been published to show superiority in results to those obtainable with conventional Roentgen therapy as initiated by Coutard and followed by many radiologists throughout the world.

When opposing lateral fields are used, there is no particular physical advantage to supervoltage, or the radium (or cobalt) cannon. With single fields, the betatron and synchrotron may have some physical advantage, but their place in clinical radiotherapy of laryngeal lesions remains uncertain.

SUMMARY.

The author's experience in the treatment of cancer of the larynx is briefly reviewed.

The results in 69 primary cases treated five or more years ago is summarized.

Of 62 cases which completed treatment, 31 were clinically arrested following treatment (50 per cent). Sixteen of these died of intercurrent disease prior to the lapse of five years and two were lost to follow-up. Of the "determinate" group of 44 cases, 13 were alive and well after five years (30 per cent).

Of 11 determinate cases, both intrinsic and extrinsic, classified as Stage I or II (that is, in the conventionally "operable" group) seven were alive and well five or more years (64 per cent). The cure rate for the intrinsic lesions alone (Stages I and II) was 80 per cent.

X-ray therapy of selected cases of early and moderately advanced carcinoma of the larynx is regarded as the optimum method of treatment for functionally satisfactory results.

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BOOK REVIEWS.

The New Way to Better Hearing, by Victor L. Browd, M.D. Crown Publishers, Inc., New York City, 1951. 226 pp. $3.00.

This volume purports to present a system of "hearing re-education" which is "so radical" and "the advantages and benefits" of which are "so great that it outmodes and replaces current hearing programs wherever it is used." The "treatment" embodies acquainting the hard-of-hearing person with the nature of his difficulties, exposing him to systematic listening experience and having him note his progress.

The author takes special pains (and perhaps delight) in deprecating "other hearing programs" without quite documenting his statements. This is unfair even in a book directed at laymen and may actually lead people away from eminently satisfactory programs. The terminology is very carelessly used. Expressions such as "*improve* the hearing," "ten years of hearing deterioration can be *reversed* in ten weeks" are loose and misleading. For his professional colleagues the author would need more objective evidence than presented in the book to prove the superiority of his "system." He should be aware that there is evidence in the literature to show that the subjective judgment of the patient about his hearing loss is not always correlated with the actual state of his hearing.

The blurbs on the jacket of the book are of interest. It is not quite clear in the body of the book how the "important new results of government tests at Harvard University" (mentioned in the blurb) are applied. We also read that "50,000,000 people suffer some definite loss in one area, which would interefere with their hearing in the case of specific sounds, or particular surroundings." This is alarmist fanfare. Obviously, every inhabitant of the land can have a hearing loss if we place him in "particular surroundings."

Nevertheless, the book does contain useful exercises which might conceivably improve auditory comprehension, but it would be more valuable if it omitted the foggy analogies, the denunciation of other systems, and the unnecessary puff. S. R. S.

Topographische Ausdeutung der Bronchien im Rontgenbild. Mit Berucksichtigung der Neuzeitlichen Nomenklatur. von Priv. Doz. Dr. Med. Claus Esser, Mainz. One hundred fifty-two pages with index and 77 illustrations. Stuttgart: Georg Thieme, Verlag. Diemershaltenstr. 47, 1951. Price DM. 33.

This book is an attempt to correlate anatomical descriptions of the bronchial tree with the findings in bronchograms. Each branch is considered in detail from the standpoint of its course, origin and relations. A discussion of the variations that may be encountered is an important part of the text. The illustrations are well labeled reproductions of bronchograms and line drawings.

The nomenclature is brought up to date and can readily be compared with a variety of terms used by previous authors.

It should prove to be of value primarily to the anatomist and Roentgenologist for teaching and research purposes. W. P. C.

CENTRAL ILLINOIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

The next meeting of the Central Illinois Society of Ophthalmology and Otolaryngology will be held at the Abraham Lincoln Hotel, Springfield, Ill., March 28, 29 and 30. The guest speakers will be Dr. James B. Costen, of St. Louis, and Dr. Trygve Gundersen, of Boston.

AMERICAN COLLEGE OF SURGEONS.

The February Sectional Meeting will be held in Atlantic City, N. J., at the Chalfonte-Haddon Hall, Feb. 11 and 12.

Your attention is called to the special program for otorhinolaryngologists and ophthalmologists. For further information address H. P. Saunders, M.D., F.A.C.S., Associate Director.

GEORGIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

The Georgia Society of Ophthalmology and Otolaryngology holds its annual meeting Friday and Saturday, March 7 and 8, 1952, at the General Oglethorpe, Wilmington Island, Savannah, Ga. Given below is a list of guest speakers and their subjects for the two days:

Dr. Murray F. McCaslin, Pittsburgh: Selection of Anesthesia in Ophthalmology.

Dr. J. Conrad Gemeroy, Detroit: External Diseases of the Eye. The Management of Metallic Intraocular Foreign Bodies.

Dr. Joseph S. Haas, Chicago: The Differential Diagnosis of the Primary Glaucoma. The Provocative Tests in Glaucoma.

Dr. Henry B. Orton, Newark: Applied Surgery of the Neck (both days).

Dr. Albert P. Seltzer, Philadelphia: Plastic Surgery of the Nose (both days).

Dr. John R. Lindsay, Chicago: "Vertigo: Differential Diagnosis and Treatment." Secretory Otitis Media.

Registration fee is $20.00. Address W. Eugene Matthews, M.D., Secretary and Treasurer, Augusta, Ga.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION.

January 2, 1952.

Audicon Models 400 and 415.
Manufacturer: National Earphone Co., Inc., 20-22 Shipman St., Newark 2, N. J.

Audivox Model Super 67.
Manufacturer: Audivox, Inc., 259 W. 14th St., New York 11, N. Y.

Aurex Model F; Model H; Models L and M.
Manufacturer: Aurex Corp., 1117 N. Franklin St., Chcago, Ill.

Beltone Harmony Mono-Pac; Beltone Symphonette; Beltone Mono-Pac Model M.
Manufacturer: Beltone Hearing Aid Co., 1450 W. 19th St., Chicago, Ill.

Cleartone Model 500; Model 700; Cleartone Regency Model.
Manufacturer: American Sound Products, Inc., 2454 S. Michigan Ave., Chicago 16, Ill.

Dahlberg Model D-1; Dahlberg Junior Model D-2.
Manufacturer: The Dahlberg Co., 2730 W. Lake St., Chicago 16, Ill.

Dysonic Model 1.
Manufacturer: Dynamic Hearing Aids, 43 Exchange Pl., New York 5, N. Y.

Electroear Model C.
Manufacturer: American Earphone Co., Inc., 10 East 43rd St., New York 17, N. Y.

Gem Hearing Aid Model V-35; Gem Model V-60.
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Maico Atomeer; Maico UE-Atomeer; Maico Quiet Ear Models G and H; Maico Model J.
Manufacturer: Maico Co., Inc., 21 North Third St., Minneapolis 1, Minn.

Mears (Crystal and Magnetic) Aurophone Model 200; 1947—Mears Aurophone Model 98.

Manufacturer: Mears Radio Hearing Device Corp., 1 W. 34th St., New York, N. Y.

Micronic Model 303; Micronic Star Model.

Manufacturer: Micronic Co., 727 Atlantic Ave., Boston 11, Mass.

Microtone T5 Audiomatic; Microtone Classic Model T9; Microtone Model T10; Microtone Model T612; Microtone Model 45.

Manufacturer: Microtone Co., Ford Parkway on the Mississippi, St. Paul, Minn.; Minneapolis 9, Minn.

National Cub Model C; National Cub Model D (Duplex); National Standard Model T; National Star Model S; National Ultrathin Model 504; National Vanity Model 506.

Manufacturer: National Hearing Aid Laboratories, 815 S. Hill St., Los Angeles 14, Calif.

Otarion Model E-4; Otarion Models F-1, F-2 and F-3; Otarion Model G-2.

Manufacturer: Otarion Hearing Aids, 159 N. Dearborn St., Chicago, Ill.

Paravox Model J (Tiny-Myte); Paravox Model XT (Xtra-Thin); Paravox Model XTS (Xtra-Thin); Paravox Model Y (YM, YC and YC-7) (Veri-Small).

Manufacturer: Paravox, Inc., 2056 E. 4th St., Cleveland, Ohio.

Radioear Permo-Magnetic Multipower; Radioear Permo-Magnetic Uniphone; Radio Ear All Magnetic Model 55; Radioear Model 62 Starlet; Model 72.

Manufacturer: E. A. Myers & Sons, 306 Beverly Rd., Mt. Lebanon, Pittsburgh, Pa.

Rochester Model R-1; Rochester Model R-2.

Manufacturer: Rochester Acoustical Laboratories, Inc., 117 Fourth St., S.W., Rochester, Minn.

Silvertone Model 103BM.
Manufacturer: National Hearing Aid Laboratories, 815 S. Hill St., Los Angeles 14, Calif.
Distributor: Sears-Roebuck & Co., 925 S. Homan Ave., Chicago 7, Ill.

Silvertone Model J-92.
Manufacturer: Sears-Roebuck Co., 925 S. Homan Ave., Chicago 7, Ill.

Silvertone Model P-15.
Manufacturer: W. E. Johnson Mfg. Co., 708 W. 40th St., Minneapolis, Minn.
Distributor: Sears, Roebuck & Co., 925 S. Homan Ave., Chicago 7, Ill.

Solo-Pak Model 99.
Manufacturer: Solo-Pak Electronics Corp., Linden St., Reading, Mass.

Sonotone Model 700; Sonotone Model 900; Sonotone Models 910 and 920; Sonotone Model 925; Sonotone Model 940.
Manufacturer: Sonotone Corp., Elmsford, N. Y.

Superfonic Hearing Aid.
Manufacturer: American Sound Products, Inc., 1303 S. Michigan Ave., Chicago 5, Ill.

Televox Model E.
Manufacturer: Televox Mfg. Co., 1307 Sansom St., Philadelphia 7, Pa.

Telex Model 22; Telex Model 97; Telex Model 99; Telex Model 200; Telex Model 300B; Telex Model 400; Telex Model 1700.
Manufacturer: Telex, Inc., Telex Park, Minneapolis 1, Minn.

Tonamic Model 50.
Manufacturer: Tonamic, Inc., 12 Russell St., Everett 49, Mass.

Tonemaster Model Royal; Model Cameo.
Manufacturer: Tonemasters, Inc., 400 S. Washington St., Peoria 2, Ill.

Trimm Vacuum Tube Model No. 300.
Manufacturer: Trimm, Inc., 400 Lake St. (P. O. Box 489), Libertyville, Ill.

Unex Model "A"; Unex Midget Model 95; Unex Midget Model 110; Unex Models 200 and 300.
Manufacturer: Nichols & Clark, Hathorne, Mass.

Vacolite Model J.
Manufacturer: Vacolite Co., 3003 N. Henderson St., Dallas 6, Tex.

Western Electric Models 65 and 66.
Manufacturer: Audivox, Inc., successor to Western Electric Hearing Aid Division, 259 W. 14th St., New York 11, N. Y.

Zenith Model 75; Zenith Miniature 75; Zenith Model Royal; Zenith Model Super Royal.
Manufacturer: Zenith Radio Corp., 6001 Dickens Ave., Chicago, Ill.

All of the accepted hearing devices employ vacuum tubes.

Accepted Hearing Aids more than five years old have been omitted from this list for brevity.

TABLE HEARING AIDS.

Aurex (Semi-Portable).
Manufacturer: Aurex Corp., 1117 N. Franklin St., Chicago (10), Ill.

Precision Table Hearing Aid.
Manufacturer: Precision Hearing Aids, 5157 W. Grand Ave., Chicago 39, Ill.

Sonotone Professional Table Set Model 50.
Manufacturer: Sonotone Corp., Elmsford, N. Y.

All of the Accepted hearing devices employ vacuum tubes.

DIRECTORY OF OTOLARYNGOLOGIC SOCIETIES.

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Vice-President: Albert C. Furstenberg, University Hospital, Ann Arbor, Mich.
Secretary: Dr. John R. Lindsay, 950 E. 59th St., Chicago 37, Ill.
Meeting: Royal York Hotel, Toronto, Canada, May 18-19, 1952.

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President: Dr. H. Marshall Taylor, 111 W. Adams St., Jacksonville, Fla.
Secretary: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia 2, Pa.
Meeting: Royal York Hotel, Toronto, Canada, May 23-24, 1952.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President Dr. C. Stewart Nash, 108 Medical Arts Bldg., Rochester, N. Y.
Meeting: Royal York Hotel, Toronto, Canada (mornings only), May 20-22, 1952.

MID-WINTER MEETINGS.

Eastern Section: Waldorf-Astoria, New York City, Jan. 11, 1952.
Council Meeting: Waldorf-Astoria, New York City, Jan. 12, 1952.
Southern Section: Academy of Medicine, Atlanta, Ga., Jan. 14, 1952.
Middle Section: Indianapolis Athletic Club, Indianapolis, Ind., Jan. 28, 1952.
Western Section: County Medical Bldg., Los Angeles, Calif., Jan. 19,20, 1952.

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Palmer House, Chicago, Ill., October 6-10, 1952.

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Treasurer: Dr. John Louzan.
Meetings are held on the third Tuesday of October, November, March and May, 7:00 P.M.
Place: Army and Navy Club, Washington, D. C.

AMERICAN COLLEGE OF SURGEONS
SCHEDULE OF SECTIONAL MEETINGS—1952

The Tutwiler Hotel, Birmingham, Ala., Thursday, Friday, Saturday, January 10, 11, 12.

El Panama Hotel, Panama City, R. P., Wednesday, Thursday, Friday, January 16, 17, 18.

Hotel Adolphus, Dallas, Tex., Monday, Tuesday, Wednesday, February 4, 5, 6.

Chalfonte-Haddon Hall, Atlantic City, N. J., Monday, Tuesday, February 11, 12.

Chateau Frontenac, Quebec City, Quebec, Monday, Tuesday, February 18, 19.

The Radisson Hotel, Minneapolis, Minn., Monday, Tuesday, Wednesday, March 24, 25, 26.

The Vancouver Hotel, Vancouver, B. C., Monday, Tuesday, Wednesday, March 31, April 1, 2.

The Pioneer Hotel, Tucson, Ariz., Monday, Tuesday, Wednesday, April 7, 8, 9.

Royal York Hotel, Toronto, Canada, Thursday, Friday, Saturday, May 15, 16, 17.

Those who plan to attend a Sectional Meeting may select the meeting which in time or place is most convenient.

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OTOSCLEROSIS STUDY GROUP.

Meeting: Palmer House, Chicago, Ill., October, 1952.

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PAN AMERICAN ASSOCIATION OF OTO-RHINO-LARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY.

Pres.: Dr. José Gros.
Sect.: Dr. Pedro Hernandez Gonzalo, Calle 8, 358, Havana, Cuba.
Meeting: Third Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Time and Place: Havana, Cuba, January 20-24, 1952.

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Chairman of E. N. T. Section: Dr. Harold Owens.
Recording Secretary, E. N. T. Section: Dr. Donald B. Hull.
Charman of Eye Section: Dr. Deane Hartman.
Recording Secretary, Eye Section: Dr. Robert Norene.
Time: 6:00 P.M., fourth Monday of each month from September to May, inclusive.

THIRD LATIN AMERICAN CONGRESS OF OTORHINOLARYNGOLOGY AND BRONCHOESOPHAGOLOGY.

Time and Place: Caracas, Venezuela, 1953.

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Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore 1, Md.

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Meeting: Salt Lake City, Utah, 1952.

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